सेन्ट्रल माईन प्लानिंग एण्ड डिजाइन इन्स्टीट्यूट लि.
कोल इंडिया लिमिटेड की अनुषंगी कंम्पनी / भारत सरकार का उपक्रम
क्षेत्रीय संस्थान-V,सीएमपीडीआई काम्प्लेक्स,सीपत रोड बिलासपुर छ.ग. 495006
Central Mine Planning & Design Institute Limited
A Subsidiary of Coal India Ltd/ A Govt. of India Public sector Undertaking
CIN:U14292JH1975GO1001223
RI-V, CMPDI Complex, Seepat Road, Bilaspur (CG)- 495006

विस्फोटन विभाग

क्र. सीएमपीडीआई/क्षेसं.5/ब्लास्टिंग/19/1180 बिलासपुर दिनांक 01.10.2019

प्रति,
महाप्रबंधक
सोहागपुर क्षेत्र

विषय : एस.ई.सी.एल. सोहागपुर क्षेत्र के अंतर्गत बंगवार भूमिगत खदान हेतु सब्सिड़ेंस एनालिसिस रिपोर्ट तैयार किये जाने बाबत |

महोदय,

आपके पत्र क्रमांक SECL/SUR/19/224 दिनांक 15/7/2019 अनुमोदित वार्षिक कार्य योजना 2019-20 के अनुसार बंगवार भूमिगत खदान हेतु सब्सिड़ेंस एनालिसिस रिपोर्ट की प्रति आवश्यक कार्यवाही हेतु इस पत्र के साथ प्रस्तुत की जा रही है |

धन्यवाद एवं सदैव अपनी सर्वोत्तम सेवाओं के आश्वासन सहित |

भवदीय,

01/10/19

क्षेत्रीय निदेशक

प्रतिलिपि

1. महाप्रबंधक योजना परियोजना विभाग, एस.ई.सी.एल., बिलासपुर

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सीएमपीडीआई
cmpdi
A Mini Ratna Company

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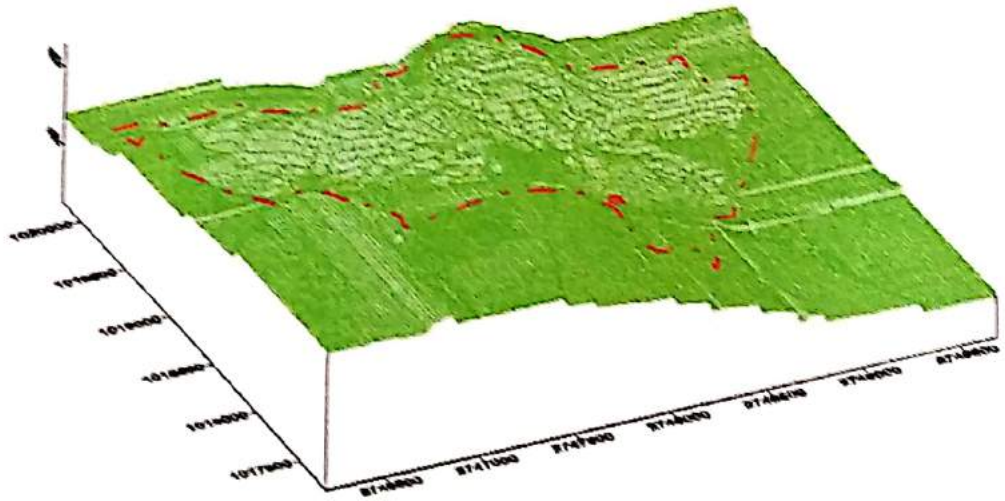
REPORT ON
SUBSIDENCE PREDICTION AND MANAGEMENT
FOR
BANGWAR UG MINE
SOHAGPUR AREA



SOUTH EASTERN COALFIELDS LIMITED
(A MINI RATNA COMPANY)
SEPTEMBER 2019

BY

REGIONAL INSTITUTE-V
CENTRAL MINE PLANNING & DESIGN INSTITUTE LTD.
(AN ISO 9001 COMPANY&A MINI RATNA COMPANY)
BILASPUR (C.G)

Report on subsidence prediction and management for Bangwar Underground Mine, Sohagpur Area, SECL.

Job No. : 538219

Customer : SECL, Through Regional Director, RI-V, CMPDI

Reference : As per Annual Action Plan 19-20

Date of submission of report : September 2019

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BANGWAR UNDERGROUND MINE, SECL

1.0 INTRODUCTION

The Bangwar UG Mine of SECL is situated in Burhar Tehsil of Shahdol District of Madhya Pradesh. It falls under the administrative control of Sohagpur area. As per survey of India topo sheet no.64E/12, it lies between:

Latitude N23^0 08' 45" & 23^0 09' 45" &

Longitude E81^0 31' 20" & 81^0 33' 00"

It is located at a distance of 35Km from Shahdol and is well connected by road. By Railroad it is approachable through Amlai Railway Station about 8Km away from mine. Three seams are being worked at Bangwar UG mine namely Seam VII, Seam VIT & Seam VIB. Brief details of the mine are given in the table below:

BRIEF DESCRIPTION OF THE MINE

SL.No.	PARTICULARS			
1	Name of Project	Bangwar U/G Mine		
2	Date of opening of the project	September, 1987		
3	Sub-Area	Khairaha-Damni-Bangwar		
4	Area	Sohagpur		
5	Tehsil	Burhar		
6	District	Shahdol		
7	State	Madhya Pradesh		
8	Nearest Railway Station	Amlai		
9	Mode of entries	**Incline no.1**	**Incline no.2**	**Incline no.3**
a	Gradient	1 in 4.0	1 in 5.0	1 in 4.5
b	Cross section	3.0mX4.8m	2.5mX4.8m	2.5mX4.8m
c	Purpose	Travelling road	Belt conveyor	Haulage Road
d	Length	146m	185m	151m
10	Number of workable seams	THREE Seam VII Seam VIT Seam VIB		

SL.No.	PARTICULARS	
11	Thickness range Seam VII Seam VIT Seam VIB	 2.5m-4.37m 2.0m-2.8m 2.0m-4.2m
12	Parting between Seams Seam VII & Seam VIT Seam VIT & Seam VIB	 3m-22m 3m to 15m
13	Presence of bands/ Other geo.Disturbances	NIL
14	Av. Grade of Coal	G-7
15	Gradient of Seam Seam VII Seam VIT Seam VIB	 1 in 15 1 in 15 1 in 16
16	Nature of roof	Sand stone and Shale
17	Nature of floor	Sand stone
18	Degree of gassiness	Ist degree
19	Crossing point temperature of seam Seam VII Seam VIT Seam VIB	 129.2°C 141.6°C 124.9°C
20	Ignition point of seam Seam VII Seam VIT Seam VIB	 148°C 155°C 168.3°C
21	Method of working	Bord and pillar (With CM & LHD)
23	Type of Drilling Machine	1)UDM 2)Hand held electric coal drills
24	Type of loading Machines	LHD & CM
25	Mode of Transportation	Belt conveyor
26	Annual production during 2018-2019	0.285MTY
27	EC Capacity	0.65 MTY

2.0 SUBSIDENCE PREDICTION :

The subsidence prediction model based on Influence Function method, developed in CMPDI, has been used for estimation of likely subsidence over the mining area. Subsidence prediction has been done for the panels proposed to be extracted by caving method in mine projection plans of seams VIB, VIT and VII. As per project report, the minimum and maximum thicknesses of extraction have been considered to be 1.5m and 4.5m. Input data used for subsidence prediction, such as mining parameters, geology, panels' dimension, sequence of extraction of the panels and surface features have been collected from project report and plans sent by area authority.

Details of mine layout, surface contours, surface features, forest and other relevant features have been digitised from surface plan and mine projection plan of seams VIB, VIT, and VII. The digitised data have been used as input parameters for subsidence prediction model.

The subsidence measurement data carried out by Bangwar Mine for 5 Nos. Panels of Seam VII & 2 Nos. Panels of Seam VIT was furnished by the Project indicating the field measurement values of subsidence on the surface of the panels already depillared in the seams. Accordingly, the values of subsidence factor and angle of draw for single and multiple seam extraction have been taken considering the rock mass of overlying strata, geo-mining conditions, method of work and subsidence data observed in the mine. The parameters taken for subsidence prediction are as follows:

i)	Subsidence factor :	0.6 for multiple seam extraction
ii)	Angle of draw :	30^0 for single seam extraction and 35^0 for multiple seam extraction.
iii)	Anticipated percentage of extraction in panels :	70%
iv)	Depth :	Average depth for each panel or part of the panel where depth varies significantly within the panel.

v) Thickness of extraction : Average thickness of the seam for each panel or part thereof. Minimum 1.5m and maximum and 4.5m.

Before subsidence prediction, the prediction model has been calibrated according to the above mentioned subsidence parameters. For subsidence calculation, underground extraction area has been divided into 20m x 20m grid blocks as individual elements. The numerical procedure followed for prediction involves estimation of subsidence at the grid points of each element and subsequent integration to arrive at resultant values and the final area influenced by ground movement. Subsidence has been calculated over 26,576 points.

Subsidence prediction has been done for five stages of mining, i.e. at the end of 5, 10, 15, 20 and at the end of mine life. Stages of depillaring of panels at 5 years intervals in seams VIB, VIT and VII are shown in different colours in Plates 2, 3 and 4 respectively. All the stages have been drawn based on the data of mine & plans etc. provided by the Mine authorities. The diversion of Kachhian Nallah provided in the plans has been considered for subsidence prediction.

3.0 SUBSIDENCE PREDICTION RESULTS :

3.1 Maximum subsidence, subsidence contours and subsidence profiles:

The anticipated maximum possible subsidence over the mining area likely to occur due to extraction of seams VII, VIT and VIB after 5, 10, 15, 20 years and at the end of mine life are 2.46m, 5.38m, 5.38m, 5.68m and 5.68m respectively. The estimated maximum possible subsidence likely to occur at the end of mine life (i.e. after 24 years of mining) is 5.68m, which is likely to take place over the panels 8 of Seam VII, 19 & 19A of seam VIT and 12 of seam VIB. In the forest area, the maximum possible subsidence likely to occur is 5.68m, which is likely to take place over the panels 8 of Seam VII, 19 & 19A of seam VIT and 12 of seam VIB. From the estimated subsidence at each grid point, subsidence contours are drawn at every 5 year stage of mining and shown in Plates 5, 7, 9, 11 and 13.

Subsidence contours along with their values have been shown in different colours shown in the legend of the plans and are self-explanatory. In all Plates

subsidence contours are shown at 1m intervals. Final subsidence profiles along lines AA' and BB' have also been drawn and shown in Plates 17 and 18 respectively.

3.2 Effect of subsidence on surface topography and surface features along with mitigative measures :

Surface topography before mining, after every 5 year stage of depillaring and at the end of mine life are shown in Plates 1, 6, 8, 10, 12 and 14. Change in topography due to subsidence can be seen by comparing the above mentioned plates. For a comparative assessment of ground condition before and after mining, 3D views of surface before and after mining, (i.e. after extraction of seams VII, VIT and VIB) are shown in Plates 15 and 16 respectively. By comparing the above two views, it is observed that there is perceptible change in surface topography. Surface profiles before mining and after final subsidence (i.e. after extraction of all the three seams) have also been drawn along lines AA' and BB' and shown in Plates 17 and 18 respectively.

The ground elevation of the mining area ranges from 488m to 503m, i.e. a difference of elevation of 15m. The Kachhain Nallah, Nargara Nallah & Ghoghra Nallah form the drainage pattern of the area. The workings below Nargara Nallah have been proposed to be developed only and no depillaring has been proposed as can be seen in Plate no. 2, 3 & 4. As per the data provided by the mine authorities, the diversion of Kachhian Nallah shall be carried out. Therefore, the maximum anticipated subsidence of 5.68m is not likely to damage or cause any safety hazard or change the drainage pattern in the area.

However, subsidence may result in the formation of depressions over the centre of the panels and cracks at the zones of high tensile strain such as along the boundary and barriers. Pools of water are likely to be formed in these depressions during rains, which may be retained wherever possible for the benefit of vegetation in the forest land or filled up/drained out by cutting drains depending on safety of underground workings.

The surface cracks, developed due to subsidence, need to be filled up properly and regularly with clay and stone chips to achieve the original drainage

pattern of the area and to prevent ingress of air and water into the goaf. This will minimise the chances of underground inundation and spontaneous heating.

For estimating the effects of subsidence on surface features, panel wise anticipated maximum possible subsidence, slope and tensile strain have been calculated due to extraction of seams VII, VIT and VIB after 5, 10, 15, 20 years and at the end of mine life are shown in Tables 1, 2, 3, 4 and 5. Strains developed due to subsidence is the prime cause of damage to the surface features. Thus, values of strains likely to occur near important surface features have been estimated to envisage the extent of damages to the surface features. The impacts of subsidence on different surface features are outlined below.

Impact of subsidence on Nargara Nallah :

The workings below Nargara Nallah have been proposed to be developed only and no depillaring has been proposed as can be seen in Plate no. 2, 3 & 4. A barrier of 15m has been proposed to be left to further safe guard the Nallah. Nargara Nallah flowing over the mining area is unlikely to be affected by subsidence as depicted in Plate no. 5, 7, 9, 11, & 13.

Impact of subsidence on Kachhian Nallah :

As per the data provided by the mine authorities, the diversion of Kachhian Nallah flowing over the mining area shall be carried out. A barrier of 60m has been proposed to be left against the proposed diversion of nallah. No subsidence effects are predicted to be observed on Kachhian nallah as depicted in Plate no. 5, 7, 9, 11, & 13.

Impact of subsidence on Ghoghra Nallah :

The Ghoghra Nallah is flowing outside the area being depillared. The diverted Kachhian Nallah is proposed to merge with the Ghoghra Nallah. No subsidence effects on the diverted nallah & Ghoghra nallah are predicted to be observed due to mining as depicted in Plate no. 13.

Impact of subsidence on PWD road :

The existing PWD road is outside the area being depillared. No subsidence effects on this road are predicted to be observed due to mining as depicted in Plate no. 5, 7, 9, 11, & 13.

Impact of subsidence on Pond 1, Pond 2 & Pond 3 :

Pond 1 lies vertically above Panels 19, 19A of Seam VIB & 18, 18A of Seam VII. It is proposed to not depillar the panels vertically below Pond 1 & a barrier of 60m from the pond has also been proposed to be left to further safeguard this surface feature.

Similarly, Pond 2 lies vertically above Panels 33, 39A & 36 of Seam VIB. . It is proposed to not depillar the panels vertically below Pond 2 & a barrier of 60m from the pond has also been proposed to be left to further safeguard this surface feature.

The Pond 3 lies vertically above Panels 42, 43, 44 & 45 of Seam VIB and panels 27 & 28 of Seam VIT. It is proposed to not depillar the panels vertically below Pond 3 & a barrier of 60m from the pond has also been proposed to be left to further safeguard this surface feature.

No subsidence effects on Pond 1 & Pond 2 are predicted to be observed due to mining as depicted in Plate no. 5, 7, 9, 11, & 13. However, the barrier left against Pond 3 is likely to be effected by a strain of 2.76 mm/m.

Impact of subsidence on Inclines & Airshaft:

Inclines 1, 2 & 3 and airshaft of the mine are unlikely to be affected by subsidence in the final stage of working as these are located outside the subsidence influence area.

Impact of subsidence on tenancy land :

The tenancy land over the mining area exists in the eastern & western side of the mine boundary as shown in Plate 1 (Topographical Plan). The eastern side tenancy land is likely to be affected by a maximum strain of 77.92 mm/m at the end

of mine life. The western side tenancy land is likely to be affected by a maximum strain of 41.12 mm/m at the end of mine life.

3.3 Effect of subsidence on forest land :

Major portion of mine area are below the forest land. The area of forest land likely to be affected by subsidence is shown in Plates relating to subsidence contours (Plate no. 13). For estimating the effect of subsidence on forest, panel wise anticipated maximum possible subsidence, slope and tensile strain have been calculated due to extraction of VII, VIT and VIB seams during the different stages of mine life. The Table no. 5 shows the values of maximum possible subsidence, slope and tensile strain and the likely width of surface cracks at the end of mine life.

The circular no. F.No. 5-3/2011-FC (Annexure I) issued by Ministry of Environment, Forest and Climate change (Forest conservation division) envisages guidelines for diversion of forest land for non-forestry purposes under the Forest (Conservation) Act, 1980 and guidelines for collection of NPV. These guidelines may be utilised for the calculation of NPV to be paid for Bangwar UG project.

4.0 SUBSIDENCE MANAGEMENT :

Considering the impact of subsidence on surface topography, forest and surface features, as explained in earlier chapters, the following subsidence management aspects are required to be undertaken to overcome or to minimise adverse effects.

i) Due to subsidence, surface cracks likely to develop over the mining area need to be filled up properly and regularly by clay and stone chips and thereafter with about 0.3m high clay heap over the cracks. It will help in achieving the original drainage pattern over the mining area, improving the water retention capacity of the soil, minimising the top soil erosion and avoiding chances of underground inundation and spontaneous heating.

ii) It is suggested that a team is formed by the mine management which will be responsible for the proper and regular filling of surface cracks developed due to subsidence.

The team will also maintain record of the development and filling of surface cracks. Adequate supply of filling materials should be arranged by mine management at the site.

iii) While planning the extraction of the different seam panels, a time lag of more than 5 years has been maintained between extraction of successive panels in superimposition. This will allow the super-incumbent strata to consolidate and settle before the extraction of lower seam. With this time lag in multiple seam extraction, depressions on the surface will take place in steps and after long intervals of time, and as a result reduced amount of slope and strain will develop on the surface.

iv) Subsidence may result in depressions on the surface with accumulation of water during the rains. Such accumulation of water may be beneficial for vegetation in the forest. These water bodies may be retained wherever possible or filled up/drained out by cutting drains depending on safety of the underground workings.

v) Surface drains should be made outside of the subsidence influence area to prevent the surface water of adjoining area from coming into active subsidence area.

vi) Coal pillars are to be left un-extracted vertically below and within subsidence influence area from the surface features which are required to be protected from subsidence damages.

vii) Considering the make of water in small seasonal streamlets existing over the mining area, due care has to be undertaken while extraction is made below these streamlets such as avoiding extraction during monsoon and filling up cracks developed in the bed of the streamlets, when dry. However, if it is required to keep these streamlets totally out of subsidence influence area, coal pillars should be left un-extracted vertically below and within angle of draw from the streamlet, i.e. within 30^0 angle of draw for single seam extraction and 35^0 angle of draw for multiple seam extraction.

The impact of subsidence on different surface features and forest land along with the degree of damage are provided in Annexure II for reference, i.e. the "Subsidence Impact Matrix". The Subsidence Impact Matrix (SIM) shown therein was developed under a Ministry of Coal funded S&T project.

5.0 CONCLUSION :

i) After extraction of all the three seams, i.e. after extraction of VII, VIT and VIB seams, the anticipated maximum possible subsidence likely to occur over the mining area is 5.68m, which is likely to take place over the panels 8 of seam VII, 19 & 19A of seam VIT and 12 of seam VIB. The estimated maximum possible slope and tensile strain likely to occur are 173.12 mm/m and 90.89 mm/m respectively over the panels 15 of seam VII, 17 of seam VIT and 11 of seam VIB.

ii) In the forest area, the maximum possible subsidence likely to occur is 5.68m over panels 8 of seam VII, 19, 19A of seam VIT and 12 of seam VIB. The estimated maximum possible slope and tensile strain likely to occur are 173.12 mm/m and 90.89 mm/m respectively over the panels 15 of seam VII, 17 of seam VIT and 11 of seam VIB. The surface cracks likely to develop are more than 300mm wide over most of the forest area.

iii) The circular no. F.No. 5-3/2011-FC (Annexure I) issued by Ministry of Environment, Forest and Climate change (Forest conservation division) envisages guidelines for diversion of forest land for non-forestry purposes under the Forest (Conservation) Act, 1980 and guidelines for collection of NPV. These guidelines may be utilised for the calculation of NPV to be paid for Bangwar UG project.

iv) Nargara Nallah flowing over the mining area is unlikely to be affected by subsidence as depicted in Plate no. 5, 7, 9, 11, & 13 and a barrier of 15m has been proposed to be left to further safe guard the Nallah.

v) A barrier of 60m shall be left unextracted below the diversion of Kachhian Nallah and no subsidence effects are predicted to be observed as depicted in Plate no. 5, 7, 9, 11, & 13.

vi) The Ghoghra Nallah is flowing outside the area being depillared. The diverted Kachhian Nallah is proposed to merge with the Ghoghra Nallah. No subsidence effects on the diverted nallah & Ghoghra nallah are predicted to be observed due to mining as depicted in Plate no. 13.

vii) The existing PWD road is outside the area being depillared. No subsidence effects on this road are predicted to be observed due to mining as depicted in Plate no. 5, 7, 9, 11, & 13.

viii) Pond 1 lies vertically above Panels 19, 19A of Seam VIB & 18, 18A of Seam VII. Pond 2 lies vertically above Panels 33, 39A & 36 of Seam VIB. The Pond 3 lies vertically above Panels 42, 43, 44 & 45 of Seam VIB and panels 27 & 28 of Seam VIT. It is proposed to not depillar the panels vertically below Pond 1, 2 & 3 & a barrier of 60m from the ponds has also been proposed to be left to further safeguard these surface features. No subsidence effects on Pond 1 & Pond 2 are predicted to be observed due to mining as depicted in Plate no. 5, 7, 9, 11, & 13. However, the barrier left against Pond 3 is likely to be effected by a strain of 2.76 mm/m.

ix) Inclines 1, 2 & 3 and airshaft of the mine are unlikely to be affected by subsidence in the final stage of working as these are located outside the subsidence influence area shown in Plate no. 13 (Subsidence contours at the end of mine life).

x) The tenancy land over the mining area exists in the eastern & western side of the mine boundary as shown in Plate 1 (Topographical Plan). The eastern side tenancy land is likely to be affected by a maximum strain of 77.92 mm/m at the end of mine life. The western side tenancy land is likely to be affected by a maximum strain of 41.12 mm/m at the end of mine life.

xi) The ground elevation of the mining area ranges from 488m to 503m, i.e. a difference of elevation of 15m. The Kachhain Nallah, Nargara Nallah & Ghoghra Nallah form the drainage pattern of the area. The workings below Nargara Nallah have been proposed to be developed only and no depillaring has been proposed as can be seen in Plate no. 2, 3 & 4. After the proposed diversion of Kachhian Nallah, the maximum anticipated subsidence of 5.68m is not likely to damage or cause any safety hazard or change the drainage pattern in the area.

xii) Surface cracks formed due to subsidence will need to be filled up with clay and stone chips and thereafter with about 0.3m high clay heap over the cracks. It will help in achieving the original drainage pattern in the mining area, improving water retention capacity of the soil, minimising the top soil erosion and avoiding chances of underground inundation and spontaneous heating.

xiii) It is suggested that the mine management forms a team that will be responsible for the proper and regular filling of surface cracks developed due to subsidence. The team will also maintain a record of the development and filling of surface cracks. Adequate supply of filling materials should be arranged by the mine management at the site.

xv) Surface drains should be made outside of the subsidence influence area to prevent the surface water of adjoining area from coming into active subsidence area.

xvi) For the safety of underground workings it will be necessary to prevent the formation of water bodies on the surface while extracting panels in the lower seam. It is also suggested that dewatering of the goaves of upper seam should be continued as long as the lower seam is worked to prevent the formation of large water bodies over the working area.

xvii) Extraction sequence is proposed to be maintained in such a manner so that extraction of upper seams will always be in advance than the lower seams.

xviii) It is recommended that while carrying out extraction in the upper seam VII, close subsidence monitoring is required to be done over some initial panels. On the basis of observed data, necessary correction in subsidence estimation may be done, if required.

...o0o...

F. No. 5-3 /2011-FC
Government of India
Ministry of Environment, Forests and Climate Change
(Forest Conservation Division)

Indira Paryavaran Bhawan,
Aliganj, Jorbagh Road,
New Delhi - 110 003
Dated: 16th March, 2016

To

The Principal Secretary (Forests)

All States/Union territories

Sub: Guidelines for diversion of forest land for non-forestry purposes under the Forest (Conservation) Act, 1980- Guidelines for collection of Net Present Value (NPV).

Sir,

I am directed to refer to this Ministry's letter No. 5-3/20009-FC dated 5th February, 2009 on the above-mentioned subject, wherein *inter-alia* it was stated that Net Present value (NPV) of forest land to be diverted for underground mining projects shall be realised at the rate of 50 % of the normal rates.

2. This Ministry received representations to exempt the forest land diverted for underground mining projects from the requirement of payment of NPV. The matter has been examined by the Forest Advisory Committee constricted by the Central Government in accordance with the provisions of the Section -3 of the Forest (Conservation) Act, 1980.

3. After careful examination of the matter in this Ministry on the basis of the recommendations of the Forest Advisory Committee, I am directed to say that in case of underground mining projects where surface strain predicted by the 3-D subsidence prediction model is less than 20 mm/m, the NPV of the forest land diverted for such projects may be realised at the further lower rates, as below:

Surface strain predicted by 3-D subsidence prediction model	NPV Rates
Up to 5 mm/m	Nil
5 mm to 10 mm/m	10 % of normal rates of NPV
10 mm/m to 15 mm/m	25% of normal rates of NPV
15 mm/m to 20 mm/m	50 % of normal rates of NPV

4. In case of the underground mining projects where surface strain predicted by 3-D subsidence prediction model is more than 20 mm/m, for the purpose of NPV such projects shall continue be treated at par with the open cast mining projects and NPV of the forest land diverted for such projects shall be realised at the normal rates of NPV.

5. The afore-mentioned revised rates of NPV shall be applicable to the cases where in-principle approval under the Forest (Conservation) Act, 1980 has been accorded after the issue of this letter.

This issues with approval of the Hon'ble Minister of State (Independent Charge) for Environment, Forest and Climate Change.

Yours faithfully,

(H.C. Chaudhary)
Director

Copy to:-

1. Prime Minister's Office (***Kind attn.:*** Shri Santosh D. Vaidya, Director).
2. Secretary, Ministry of Coal, Government of India.
3. Secretary, Ministry of Mines, Government of India.
4. Secretary, Ministry of Steel, Government of India.
5. Principal Chief Conservator of Forests, all State/UT Governments.
6. Nodal Officer, the Forest (Conservation) Act, 1980, all State/UT Governments.
7. All Regional Offices, Ministry of Environment, Forests and Climate Change (MoEFCC), GoI.
8. Joint Secretary in-charge, Impact Assessment Division, MoEFCC, GoI.
9. All Assistant Inspector General of Forests/ Directors in the Forest Conservation Division, MoEFCC, GoI.
10. Director Regional Office Headquarters Division, MoEFCC, GoI.
11. Sr. Director (Technical), NIC, MoEFCC with a request to place a copy of the letter on website of this Ministry.
12. Sr. PPS to the Secretary, Ministry of Environment, Forest and Climate Change.
13. Sr. PPS to the Director General of Forests & Special Secretary, MoEFCC, GoI.
14. Sr. PPS to the Addl. Director General of Forests (Forest Conservation), MoEFCC, GoI.
15. PS to the Inspector General of Forests (Forest Conservation), MoEFCC, GoI.
16. Guard File.

(H.C. Chaudhary)
Director

ANNEXURE-II

SUBSIDENCE IMPACTS

The Subsidence Impact Matrix given below shows the degrees of damage for various surface features, including forest land, vis-à-vis subsidence. Slope and strain values was developed as part of a Ministry of Coal funded S&T Project and is extracted from the **S&T Report titled "Subsidence in Mining Areas" by CMRI.**

Sl.No.	Impact	Subsidence (mm)	Slope (mm/m)	Strain (mm/m)
	SURFACE TOPOGRAPHY			
1.	Practically no impact	<500	<3	<3
2.	Some fine cracks or one or two 50mm wide cracks with visible depression	<500 500-1000	3-5 5-10	3-5 3-5
3.	A large no. of fine cracks or a few 100mm wide cracks with marked depression	500-2000	10-20	5-10
4	A large no. of 50-100mm wide cracks or a few 200mm wide cracks with stepping. Marked distortion in surface topography.	500-2000	>20	10-20
5.	500mm wide cracks with stepping and prominent distortion in surface topography.	>1000	>50	20-50
6.	Many 500mm wide cracks some upto 1000mm width, large stepping. Severe distortion in surface topography.	>2000	>100	50-100
7.	Very severe distortion in surface topography. Stepped subsidence with very wide cracks.	>2000	>100	>100
	SURFACE WATER BODIES (Ponds, Rivers, Nallas, Jores, HFL)			
1.	Practically no impact No loss of water	<500	<3	<3
2.	Marginal impact in some cases only. Some loss of water and water logging	<1000	<5	<5
3.	Severe impacts. Major loss of water. Severe water logging	>1000	>5	>5
	SUB-SURFACE WATER TABLE			
1.	Marginal depletion in water retaining capacity	<500	<3	<3

Sl.No.	Impact	Subsidence (mm)	Slope (mm/m)	Strain (mm/m)
2.	Severe depletion in water retaining capacity	-	-	>5
	AQUIFERS			
1.	Depletion in water retaining capacity	-	-	>3
	WATER LOGGING ON SURFACE			
1.	Very little waterlogging	<500	-	-
2.	Some(300-500mm deep depending on surface topography)	500-1000	-	-
3.	Marked waterlogging	>1000	-	-
	ROADS			
1.	Practically no impact	<500	<5	-
2.	Depressions with gentle slope	-	5-10	-
3.	Steeper slopes (speed restriction may be necessary)	-	20-50	-
4.	Marginal repairs necessary	-	20-50	>10
5.	Major repairs necessary	-	>50	>10
	RAILWAY LINES – JOINTED CONSTRUCTION			
1.	Practically no impact	-	<10	<3
2.	Minor to severe impact, repairs necessary due to bending twisting and breaking of rails and steeper gradients.	-	>10	>3
	RAILWAY LINES – WELDED CONSTRUCTION			
1.	No subsidence permitted. Even very small strain can cause twisting and breaking of rails.			
	RAILWAY SIDINGS – JOINTED CONSTRUCTION			
1.	Practically no impact	-	<10	<3
2.	Minor to severe impact, repairs necessary.	-	>10	>3
	SINGLE STOREY HUTMENTS (Kuccha)			
1.	Practically no impact. A few fine cracks in plastered walls	-	<5	<3
2.	Minor repairable impacts. Fine cracks. A few 10mm wide cracks	-	<10	3-5
3.	Major/severe impacts. Wide cracks, stepping, tilting	-	>10	>5
	SINGLE STOREY BUILDINGS			
1.	Very little impact. A few fine cracks or one/two 5-10mm wide cracks	-	<5	<3
2.	Little repairable impact. 5-10mm wide cracks, slight displacement of walls against roof, doors and	-	5-10	3-5

Sl.No.	Impact	Subsidence (mm)	Slope (mm/m)	Strain (mm/m)
	windows getting slightly jammed.			
3.	Severe impacts, major repair necessary. Wider cracks, stepping, crushing and tilting. Gaps between walls and roof.	-	>10	>5
	DOUBLE STOREY BUILDINGS			
1.	Very little impact. A few fine cracks or one/two 5-10mm wide cracks	-	<5	<3
2.	Little repairable impact. 5-10mm wide cracks, slight displacement of walls against roof, doors and windows getting slightly jammed.	-	5-10	3-5
3.	Severe impacts, major repair necessary. Wider cracks, stepping, crushing and tilting. Gaps between walls and roof.	-	>10	>5
	MULTI-STOREY BUILDINGS			
1.	Little impact, repairable 5-10mm wide cracks, doors and windows getting slight jamming, displacement of walls against roof.	-	<5	<3
2.	Severe impacts. Wider cracks, crushing and tilting and stepping.	-	>5	>3
	LARGE BUILDINGS, MOVEMENTS, HISTORICAL BUILDINGS, ETC.			
1.	Very little impact. A few fine cracks or one/two 5-10mm wide cracks		<3	<1.5
2.	Little impact. 5-10mm wide cracks. Damage to decorations. Slight displacement. Doors and windows getting jammed.	-	3-5	1.5-3
3.	Severe impacts, Wider cracks, crushing etc. Major repairs necessary.	-	>5	>3
	AERIAL ROPEWAYS			
1.	Practically no impact.	-	<5	<3
2.	Little repairable impacts.	-	5-10	3-5
3.	Severe impacts. Ropes may leave pullies due to change in alignment. Tilting of pylons. Buckling of structure.	-	>10	>5

Sl.No.	Impact	Subsidence (mm)	Slope (mm/m)	Strain (mm/m)
	HIGH TENSION PYLONS			
1.	Practically no impact	-	<5	<3
2.	Severe impacts, Tilting, buckling and may be collapse of pylons	-	<5	<3*
	UNDERGROUND CABLES			
1.	Practically no impact	-	-	<3
2.	Severe impacts (cables may break due to tension)	-	-	>3*
	UNDERGROUND PIPELINES			
1.	Practically no impact	-	-	<1.5
2.	Severe impacts. Breaking of pipes.	-	-	>1.5
	OVERLYING VIRGIN SEAMS			
1.	Practically no impact. No visible signs of subsidence when the seams are developed.	-	<5	<3
2.	A little impact. A little crushing of coal, roof and floor rock. Fire risk when development is done in upper seam	-	5-10	3-5
3.	Severe impacts. Crushing of coal,roof and floor rock. Stepping in tensile strain zone. Fire risk. Heaving supports necessary during development	-	10-20	5-10
4.	Very severe impacts. Severe curshing, large stepping, entry into subsided area rather difficult. High fire risk. Arching necessary.	-	>20	>10
	OVERLYING WORKINGS (Standing on developed pillars)			
1.	Practically no impact on galleries and pillars.some spalling.	-	<5	<3
2.	Visible floor lifting, side spalling and roof falls. Supports required. Fire risk.	-	-	3-5
3.	Marked floor lifting, side spalling and roof falls. High fire risks. Workings unsafe.	-	-	5-10
4.	Severe floor lifting, large roof falls, wide spread side spalling, stepping, very high fire risk, workings unsafe.	-	-	>10

Sl.No.	Impact	Subsidence (mm)	Slope (mm/m)	Strain (mm/m)
	OVERLYING WORKINGS (Standing on reduced pillars)			
1.	Practically no impact.	-	<3	<1.5
2.	Marginal impact on stability of stooks. The stooks with marginal factor of safety may collapse increasing loading on adjoining stooks.	-	<5	<5
3.	Failure of few stooks may lead to chain of failures causing partial or total collapse of area. Thus causing additional subsidence on overlying horizons.	-	>5	>3
	OVERLYING WORKINGS (Packed or stowed)			
1.	Practically no impact on stowed workings. Some loss of water	-	-	<5
2.	Complete loss of water from stowed areas and also from adjoining rise side areas	-	-	>5
	WATERLOGGED OVERLYING WORKINGS (Standing on developed pillars)			
1.	Practically no impact on pillars, galleries and water retaining capacity of the workings.	-	-	<3
2.	Marginal loss of water through fine cracks in strata around. Dewatered areas may have risk of fires, roof falls, side spalling, floor lifting	-	-	<5
3.	Major loss of water. High fire risk in dewatered areas with roof falls, side spalling, floor lifting, etc.	-	-	5-10
4.	Total loss of water. Very high fire risk with severe floor lifting, roof falls and spalling.	-	-	>10
	WATERLOGGED OVERLYING WORKINGS (Standing on reduced Pillars / stooks)			
1.	Stooks may collapse causing additional subsidence on surface.	-	-	>3

Sl.No.	Impact	Subsidence (mm)	Slope (mm/m)	Strain (mm/m)
2.	Partial loss of water. Collapse of stooks. Additional surface subsidence. Fire risk.	-	-	3-5
3.	Total loss of water. Collapse of workings. Additional surface subsidence. Fire risk	-	-	>5
IN CURRENT WORKINGS FROM SUBSIDENCE AT THE LEVEL OF SURFACE				
1.	Practically no impact.	-	-	<5
2.	Leakage of air. Fire in goaves at shallow depth	-	-	>5
IN CURRENT WORKINGS FROM SUBSIDENCE AT THE LEVEL OF OVERLYING WATER BODIES.				
1.	Practically no impact.	-	-	<3
2.	Marginal increase in make of water	-	-	3-5
3.	Appreciable increase in make of water	-	-	5-10
4.	Heavy increase in make of water, which may lead to inundation.	-	-	>10
SURFACE ATMOSPHERE				
1.	Practically no impact	-	-	<5
2.	Some air from underground workings at shallow depth may leak to surface.	-	-	5-10
3.	Air leakage from shallow depth workings. If the workings have fire, surface atmosphere is likely to be polluted by gases coming from the fire.	-	-	>10
SUB-SOIL				
1.	Practically no impact.	-	-	<3
2.	Very little impact in the form of reduction of water retaining capacity	-	-	3-5
3.	Temporary loss in water retaining capacity. Cracks filling may improve water retaining capacity.	-	-	5-10
4.	Long term loss of water retaining capacity. Suitable protective measures necessary.	-	-	>10
AGRICULTURE				
1.	Practically no impact	-	-	<5

Sl.No.	Impact	Subsidence (mm)	Slope (mm/m)	Strain (mm/m)
2.	Marginal impact, i.e. reduction in yield due to loss in water retaining capacity of sub soil	-	-	5-10
3.	Major impact, i.e. sizeable reduction in yield	-	-	>10
	FOREST AND PLANTATION			
1.	Practically no impact	-	<10	<5
2.	Temporary loss in water retaining capacity of top soil may affect undergrowth slightly. Slight tilting of plants/trees	-	10-20	5-10
3.	Short term impact on trees in zones having cracks. The cracks may get filled in due course. Tilting of trees.	-	20-50	10-20
4.	Wide cracks may severely affect undergrowth but may not have much impact on large trees except those in the tensile strain zone where wide cracks develop. High tilting may cause some trees to fall in the high slope zone.	-	>50	>20

BANGWAR UNDERGROUND MINE, SECL

Table-1

Anticipated maximum possible subsidence, slope and tensile strain over mining area at the end of 5 Years

Sl No	Panel Name	Average Depth(m)	Maximum Subsidence (mm)	Maximum Slope (mm/m)	Maximum Tensile strain (mm/m)	Likely width of surface Cracks (mm)
1	VII1	48.00	2400	100.00	52.50	>300
2	VII2	51.00	2400	94.12	49.41	>300
3	VII3	50.50	2700	106.93	56.14	>300
4	VII4	68.50	2100	61.31	32.19	>300
5	VII5	66.40	2160	65.06	34.16	>300
6	VII6	68.40	2140	62.57	32.85	>300
7	VII7	62.40	2160	69.23	36.35	>300
8	VII8	60.30	2220	73.63	38.66	>300
9	VII9	40.90	2460	120.29	63.15	>300
10	VII10	47.00	2400	102.13	53.62	>300
11	VII11	54.00	2400	88.89	46.67	>300
12	VII12	44.00	2400	109.09	57.27	>300
13	VII13	42.00	1800	85.71	45.00	>300
14	VIT20	102.30	1300	25.42	13.34	<150
15	VIT21	99.10	1210	24.42	12.82	<100
16	VIT22	96.60	1030	21.33	11.20	<100
17	VIT23	91.00	1620	35.60	18.69	<300
18	VIT23A	95.00	1540	32.42	17.02	<200

BANGWAR UNDERGROUND MINE, SECL

Table-2

Anticipated maximum possible subsidence, slope and tensile strain over mining area at the end of 10 Years

Sl. No.	Panel Name	Average Depth(m)	Maximum Subsidence (mm)	Maximum Slope (mm/m)	Maximum Tensile strain (mm/m)	Likely width of surface Cracks (mm)
1	VII1, VIT2, VIT3, VII5	83.50	3900	93.41	49.04	>300
2	VII2,VII6, VIT5,VIT4	83.50	4790	114.73	60.23	>300
3	VII4, VIT1	88.90	3360	75.59	39.69	>300
4	VIT6, VII7	84.80	3430	80.90	42.47	>300
5	VII3, VIT7, VIT8	78.80	5380	136.55	71.69	>300
6	VII8,VIT19, VIT19A	81.60	3660	89.71	47.10	>300
7	VII11,VIT12, VIT11	79.00	5070	128.35	67.39	>300
8	VII12, VIT13, VIT10	73.50	4550	123.81	65.00	>300
9	VII10, VIT13, VIT9	74.50	5030	135.03	70.89	>300
10	VII13, VIT14	68.20	4000	117.30	61.58	>300
11	VII9, VIT13, VIT14	68.20	4550	133.43	70.05	>300
12	VII14,VIT15	57.20	3600	125.87	66.08	>300
13	VII15, VIT16	52.40	3480	132.82	69.73	>300
14	VIT20	102.30	1300	25.42	13.34	<150
15	VII16	84.90	1250	29.45	15.46	<200
16	VII17	91.00	1800	39.56	20.77	>300
17	VIT21	99.10	1210	24.42	12.82	<100
18	VIT22	96.60	1030	21.33	11.20	<100
19	VIT23	91.00	1620	35.60	18.69	<300
20	VIT23A	95.00	1540	32.42	17.02	<200

BANGWAR UNDERGROUND MINE, SECL

Table-3

Anticipated maximum possible subsidence, slope and tensile strain over mining area at the end of 15 Years

Sl. No.	Panel Name	Average Depth(m)	Maximum Subsidence (mm)	Maximum Slope (mm/m)	Maximum Tensile strain (mm/m)	Likely width of surface Cracks (mm)
1	VII1, VII5, VIT2, VIT3	83.50	3900	93.41	49.04	>300
2	VII2,VII6, VIT4, VIT5	83.50	4790	114.73	60.23	>300
3	VII4, VIT1, VIB5	88.90	5240	117.89	61.89	>300
4	VIT6, VII7	84.80	3530	83.25	43.71	>300
5	VII3, VIT7, VIT8	78.80	5380	136.55	71.69	>300
6	VII8,VIT19, VIT19A	81.60	3660	89.71	47.10	>300
7	VII11,VIT12, VIT11	79.00	5070	128.35	67.39	>300
8	VII12, VIT13, VIT10	73.50	4550	123.81	65.00	>300
9	VII10, VIT13, VIT9	74.50	5030	135.03	70.89	>300
10	VII13, VIT14	68.20	4000	117.30	61.58	>300
11	VII9, VIT13, VIT14	68.20	4550	133.43	70.05	>300
12	VII14,VIT15	57.20	3600	125.87	66.08	>300
13	VII15, VIT16, VIT17	52.40	3600	137.40	72.14	>300
14	VII20	102.30	1200	23.46	12.32	<100
15	VII16	84.90	2140	50.41	26.47	>300
16	VII17	91.00	3530	77.58	40.73	>300
17	VII18	99.10	3660	73.86	38.78	>300
18	VII18A	96.60	1800	37.27	19.57	<300
19	VII19, VIT20	91.00	2500	54.95	28.85	>300
20	VII21, VIT21	95.00	2240	47.16	24.76	>300
21	VII22, VIT22	99.1	1840	37.13	19.50	<300
22	VII25, VIT23, VIT23A	91	3390	74.51	39.12	>300
23	VII23	53.6	1440	53.73	28.21	>300
24	VII24	61.55	1470	47.77	25.08	>300
25	VIT18	33	1500	90.91	47.73	>300
26	VII16, VIB15	123.8	3000	48.47	25.44	>300
27	VIT24	57.5	1790	62.26	32.69	>300
28	VIT24A	69	1730	50.14	26.33	>300
29	VIT25	58	1790	61.72	32.41	>300
30	VIT25A	68.5	1800	52.55	27.59	>300
31	VIT26	51	1800	70.59	37.06	>300
32	VIT27	36	1800	100.00	52.50	>300
33	VIT28	29.5	1800	122.03	64.07	>300
34	VIIMD1, VITMD2	53	2950	111.32	58.44	>300
35	VIIMD2, VITMD3	85	2620	61.65	32.36	>300
36	VIIMD3, VITMD4	91	3530	77.58	40.73	>300
37	VITMD1	35	950	54.29	28.50	>300

BANGWAR UNDERGROUND MINE, SECL

Table-4

Anticipated maximum possible subsidence, slope and tensile strain over mining area at the end of 20 Years

Sl. No.	Panel Name	Average Depth(m)	Maximum Subsidence (mm)	Maximum Slope (mm/m)	Maximum Tensile strain (mm/m)	Likely width of surface Cracks (mm)
1	VII1, VII5, VIT2, VIT3	83.50	4050	97.01	50.93	>300
2	VII2,VII6, VIT4, VIT5,	83.50	4790	114.73	60.23	>300
3	VII3, VIT7	78.80	5380	136.55	71.69	>300
4	VIB5, VIT1, VII4	94.80	5240	110.55	58.04	>300
5	VIB6, VII6, VIT2, VIT4, VII5	99.60	4790	96.18	50.50	>300
6	VIB7, VIT6, VII7	95.10	5310	111.67	58.63	>300
7	VIT8, VII3	72.50	5380	148.41	77.92	>300
8	VIT9, VII10, VII11	74.50	5070	136.11	71.46	>300
9	VIT10, VII12	73.50	5130	139.59	73.29	>300
10	VIT11, VII12, VII11	79.00	5130	129.87	68.18	>300
11	VIT12, VII11	75.00	5070	135.20	70.98	>300
12	VIT13, VII12, VII10, VII9	66.50	5650	169.92	89.21	>300
13	VIT19, VIB12, VII8	90.60	5680	125.39	65.83	>300
14	VIT19A, VII8, VIB12	90.60	5680	125.39	65.83	>300
15	VIT14, VIB8, VII13, VII9	76.10	5650	148.49	77.96	>300
16	VIB9, VII14, VIT15, VII13	72.10	5640	156.45	82.14	>300
17	VIB10, VIT15, VIT16, VII14, VII5	68.00	5640	165.88	87.09	>300
18	VIT17, VII15	41.50	5280	254.46	133.59	>300
19	VIT18, VIB13	52.80	2790	105.68	55.48	>300
20	VIB14	41.60	1440	69.23	36.35	>300
21	VIB21	140	1580	22.57	11.85	<100
22	VIB15, VII16	123.8	3010	48.63	25.53	>300
23	VII17, VIB17	125.9	3950	62.75	32.94	>300
24	VII18A, VIB19A	129.5	3160	48.80	25.62	>300
25	VIB19, VII18	129.5	3190	49.27	25.86	>300
26	VIB20	135.5	2320	34.24	17.98	<200
27	VIB23, VII20, VIT20	118.5	4620	77.97	40.94	>300
28	VIB24	124.5	810	13.01	6.83	<50
29	VIB25, VII21, VIT21	119	4000	67.23	35.29	>300
30	VIB26, VII19, VIT20	115	4620	80.35	42.18	>300
31	VIB28, VII23	94.3	2630	55.78	29.28	>300
32	VIB31, VII24	83.5	3270	78.32	41.12	>300
33	VIB29, VIT22, VII21, VII22	110.5	4000	72.40	38.01	>300
34	VIB30, VIT22, VII21, VII22	117	4000	68.38	35.90	>300
35	VIB32, VII22	94.4	3080	65.25	34.26	>300
36	VIB38	77	3740	97.14	51.00	>300
37	VIB34, VIT23, VIT23A	107	5010	93.64	49.16	>300
38	VIB35, VII25, VIT23, VIT23A	100	5010	100.20	52.61	>300
39	VIB33	81.5	1530	37.55	19.71	<300
40	VIB39	58.5	1200	41.03	21.54	>300
41	VIB39A	61	1200	39.34	20.66	>300
42	VIB41	49.5	1200	48.48	25.45	>300
43	VIB43, VIT28	50.3	3120	124.06	65.13	>300
44	VIB36, VIT24, VIT24A	77	3840	99.74	52.36	>300
45	VIB37, VIT25A	86.5	3680	85.09	44.67	>300
46	VIB38, VIT24, VIT25	77	3840	99.74	52.36	>300
47	VIB40, VIT26	63.8	3420	107.21	56.29	>300
48	VIB42, VIT27	51.8	3420	132.05	69.32	>300
49	VIB44	36.6	1440	78.69	41.31	>300
50	VIB45	38.6	1440	74.61	39.17	>300
51	VITMD1	35	950	54.29	28.50	>300
52	VIIMD1, VITMD2	53	2950	111.32	58.44	>300
53	VIIMD2, VITMD3	85	2620	61.65	32.36	>300
54	VITMD4, VIIMD3	91	3570	78.46	41.19	>300

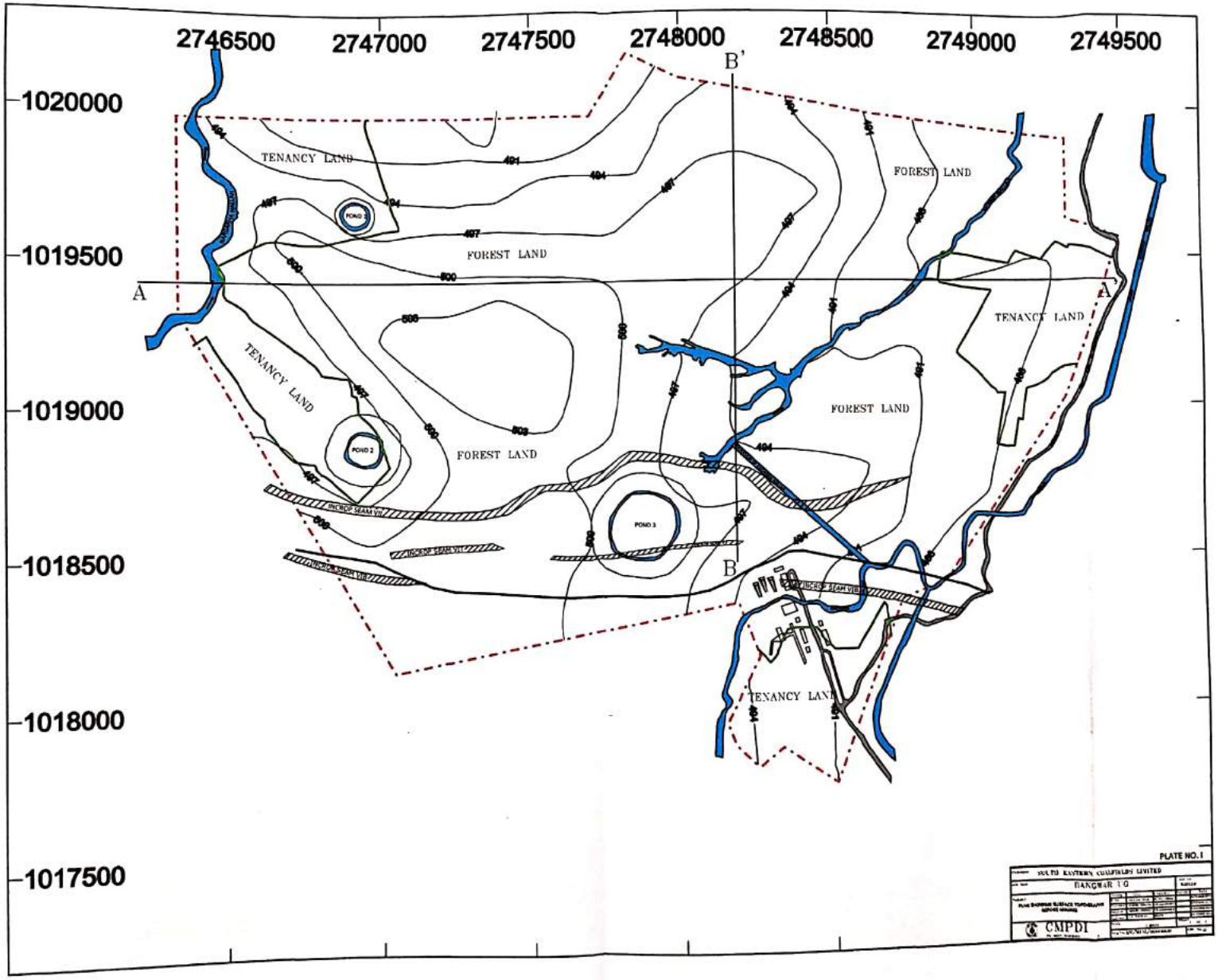
BANGWAR UNDERGROUND MINE, SECL

Table-5

Anticipated maximum possible subsidence, slope and tensile strain over mining area at the end of Mine Life

Sl. No.	Panel Name	Average Depth(m)	Maximum Subsidence (mm)	Maximum Slope (mm/m)	Maximum Tensile strain (mm/m)	Likely width of surface Cracks (mm)
1	VIT19, VIB12, VII8	90.60	5680	125.39	65.83	>300
2	VIT19A, VII8, VIB12	90.60	5680	125.39	65.83	>300
3	VIT13, VII12, VII10, VII9	66.50	5650	169.92	89.21	>300
4	VIT14, VIB8, VII13, VII9	76.10	5650	148.49	77.96	>300
5	VIB10, VIT15, VIT16, VII14, VII5	68.00	5640	165.88	87.09	>300
6	VIB9, VII14, VIT15, VII13	72.10	5640	156.45	82.14	>300
7	VIB11, VIT17, VII15	62.50	5410	173.12	90.89	>300
8	VIT8, VII3	72.50	5380	148.41	77.92	>300
9	VII3, VIT7	78.80	5380	136.55	71.69	>300
10	VIB7, VIT6, VII7	95.10	5310	111.67	58.63	>300
11	VIB27, VIIMD3, VII4, VIT1	101.7	5290	111.60	58.59	>300
12	VIB5, VIT1, VII4	94.80	5290	111.60	58.59	>300
13	VIT10, VII12	73.50	5130	139.59	73.29	>300
14	VIT11, VII12, VII11	79.00	5130	129.87	68.18	>300
15	VIT9, VII10, VII11	74.50	5070	136.11	71.46	>300
16	VIT12, VII11	75.00	5070	135.20	70.98	>300
17	VIB35, VII25, VIT23, VIT23A	100	5010	100.20	52.61	>300
18	VIB34, VIT23, VIT23A	107	5010	93.64	49.16	>300
19	VIIMD2, VITMD3, VIBMD4	101	4980	98.61	51.77	>300
20	VIBMD5, VITMD4, VIIMD3	101	4980	98.61	51.77	>300
21	VII2,VII6, VIT4, VIT5	83.50	4790	114.73	60.23	>300
22	VIB6, VII6, VIT2, VIT4, VII5	99.60	4790	96.18	50.50	>300
23	VIBMD3, VIIMD1, VITMD2	101	4660	81.04	42.55	>300
24	VIB26, VII19, VIT20	115	4620	80.35	42.18	>300
25	VIB23, VII20, VIT20	118.5	4620	77.97	40.94	>300
26	VII1, VII5, VIT2, VIT3	83.50	4050	97.01	50.93	>300
27	VIB29, VIT22, VII21, VII22	110.5	4000	72.40	38.01	>300
28	VIB30, VIT22, VII21, VII22	117	4000	68.38	35.90	>300
29	VIB25, VII21, VIT21	119	4000	67.23	35.29	>300
30	VII17, VIB17	125.9	3950	62.75	32.94	>300
31	VIB36, VIT24, VIT24A	77	3840	99.74	52.36	>300
32	VIB38, VIT24, VIT25	77	3840	99.74	52.36	>300
33	VIB38	77	3740	97.14	51.00	>300
34	VIB37, VIT25A	86.5	3680	85.09	44.67	>300
35	VIB42, VIT27	51.8	3420	132.05	69.32	>300
36	VIB40, VIT26	63.8	3420	107.21	56.29	>300
37	VIB31, VII24	83.5	3270	78.32	41.12	>300
38	VIB19, VII18	129.5	3190	49.27	25.86	>300
39	VII18A, VIB19A	129.5	3160	48.80	25.62	>300
40	VIB43, VIT28	50.3	3120	124.06	65.13	>300
41	VIB32, VII22	94.4	3080	65.25	34.26	>300
42	VIB15, VII16	123.8	3010	48.63	25.53	>300
43	VIT18, VIB13	52.80	2790	105.68	55.48	>300
44	VIB28, VII23	94.3	2630	55.78	29.28	>300
45	VIB20	135.5	2320	34.24	17.98	<200
46	VITMD1, VIBMD1	49	2190	31.29	16.43	>300
47	VIB21	140	1580	22.57	11.85	<100
48	VIB33	81.5	1530	37.55	19.71	<300
49	VIB44	36.6	1440	78.69	41.31	>300
50	VIB45	38.6	1440	74.61	39.17	>300
51	VIB14	41.60	1440	69.23	36.35	>300
52	VIBMD2	60	1420	57.37	30.12	<150
53	VIB41	49.5	1200	48.48	25.45	>300
54	VIB39	58.5	1200	41.03	21.54	>300
55	VIB39A	61	1200	39.34	20.66	>300
56	VIB24	124.5	810	13.01	6.83	<100

PLATES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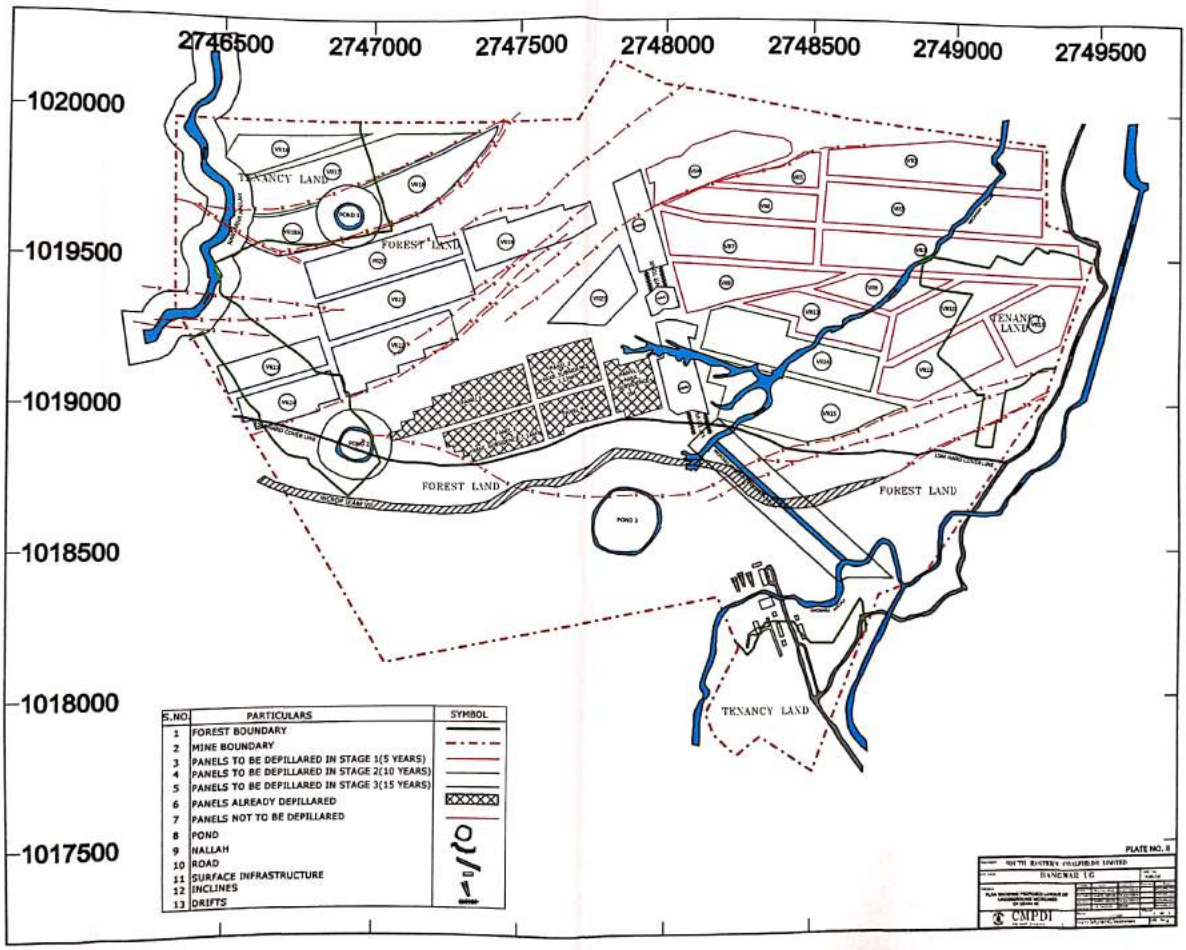
A
A'
B
B'
TENANCY LAND
FOREST LAND
POND 1
POND 2
POND 3
INCROP SEAM VII
PLATE NO. I
BANGWAR TG
CMPDI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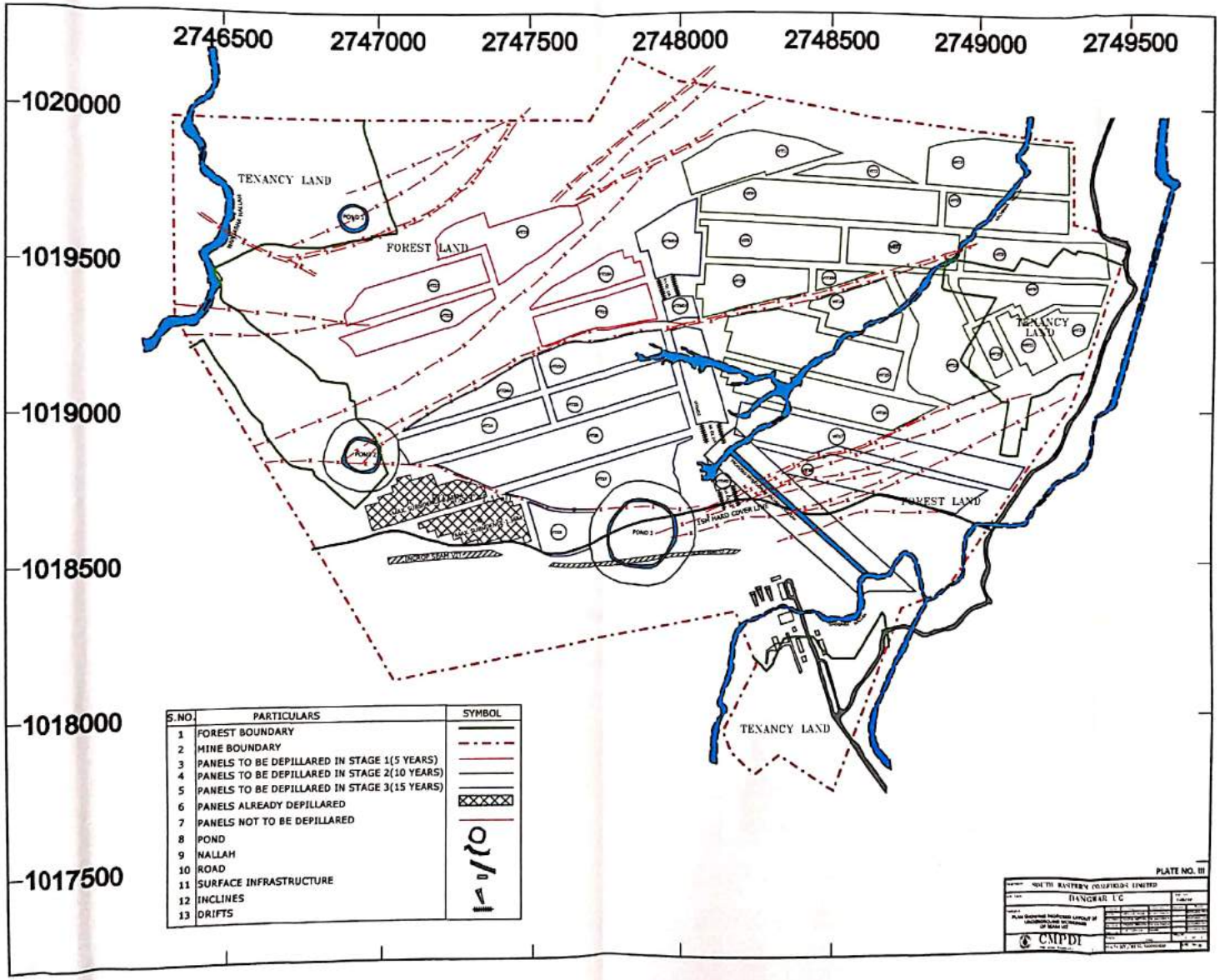
FOREST LAND
FOREST LAND
FOREST LAND
TENANCY LAND
TENANCY LAND
POND 1
POND 2
POND 3
S.NO. PARTICULARS SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 PANELS TO BE DEPILLARED IN STAGE 1(5 YEARS)
4 PANELS TO BE DEPILLARED IN STAGE 2(10 YEARS)
5 PANELS TO BE DEPILLARED IN STAGE 3(15 YEARS)
6 PANELS ALREADY DEPILLARED
7 PANELS NOT TO BE DEPILLARED
8 POND
9 NALLAH
10 ROAD
11 SURFACE INFRASTRUCTURE
12 INCLINES
13 DRIFTS
PLATE NO. II
BANGWAR 1/6
CMPDI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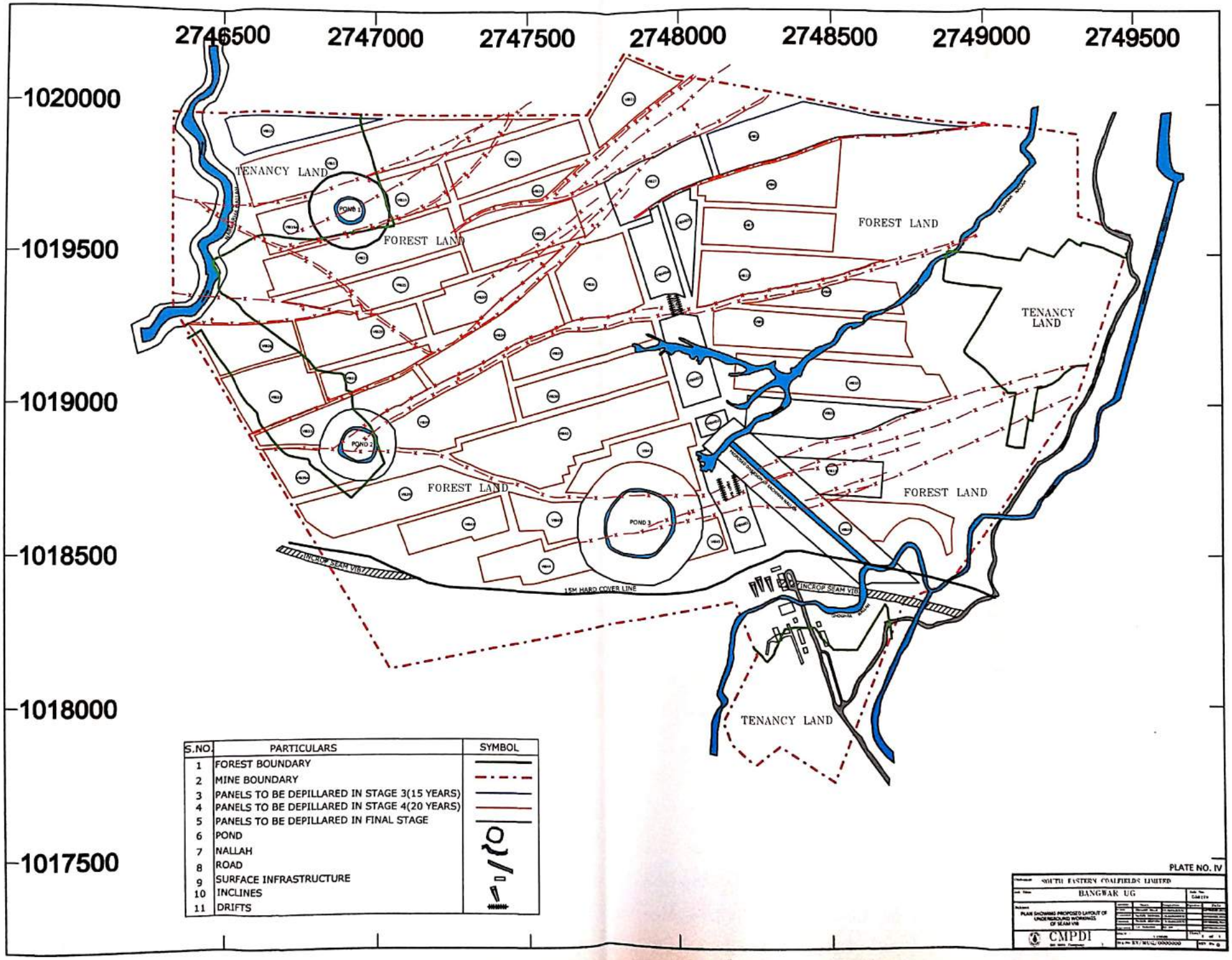
TENANCY LAND
FOREST LAND
TENANCY LAND
FOREST LAND
TENANCY LAND
POND 1
POND 2
S.NO.
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 PANELS TO BE DEPILLARED IN STAGE 1(5 YEARS)
4 PANELS TO BE DEPILLARED IN STAGE 2(10 YEARS)
5 PANELS TO BE DEPILLARED IN STAGE 3(15 YEARS)
6 PANELS ALREADY DEPILLARED
7 PANELS NOT TO BE DEPILLARED
8 POND
9 NALLAH
10 ROAD
11 SURFACE INFRASTRUCTURE
12 INCLINES
13 DRIFTS
PLATE NO. III
HANGWAR T C
CMPDI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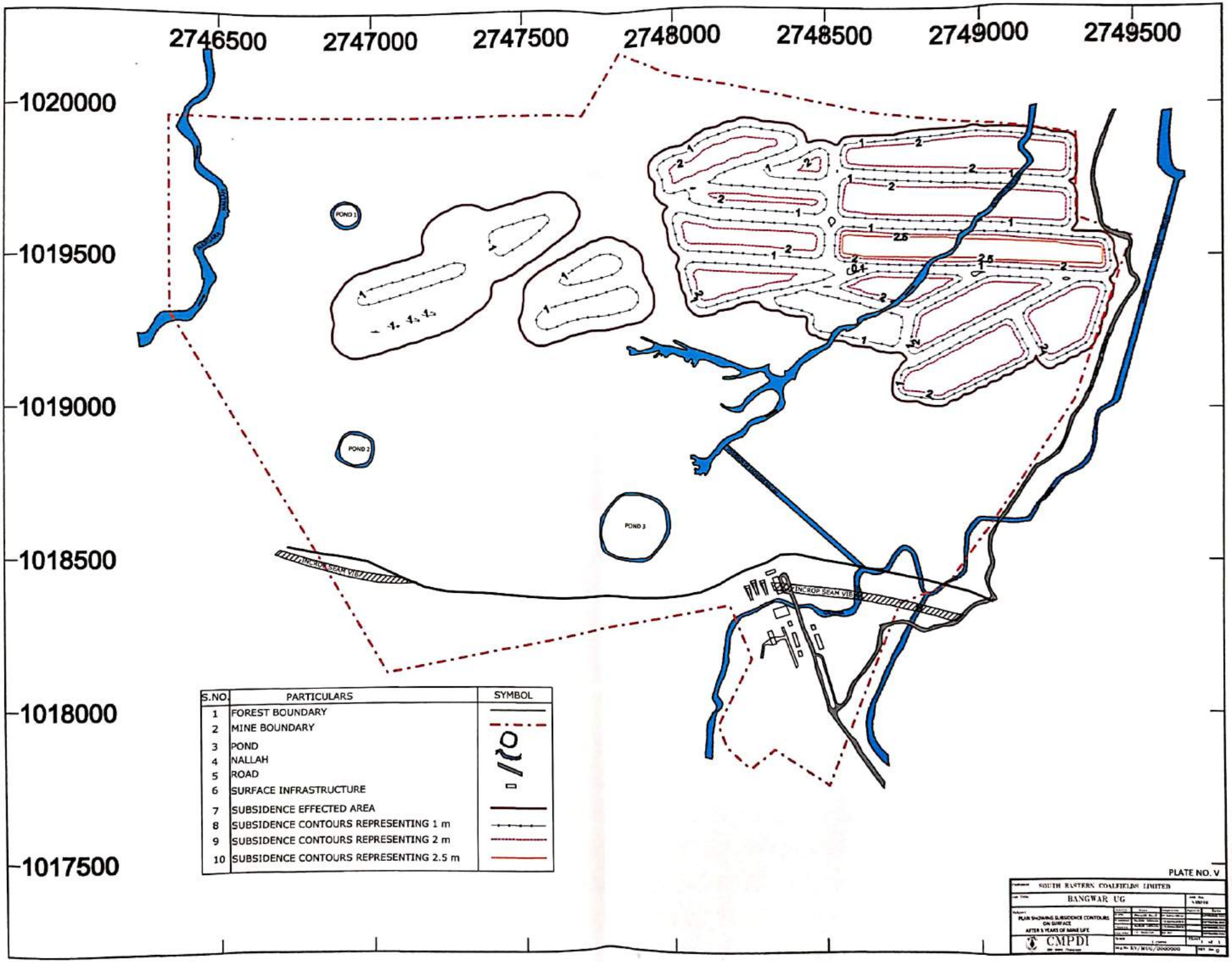
TENANCY LAND
FOREST LAND
FOREST LAND
TENANCY LAND
FOREST LAND
FOREST LAND
TENANCY LAND
POND 1
POND 2
POND 3
INCROP SEAM VIB
15M HARD COVER LINE
INCROP SEAM VIB
S.NO.
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 PANELS TO BE DEPILLARED IN STAGE 3(15 YEARS)
4 PANELS TO BE DEPILLARED IN STAGE 4(20 YEARS)
5 PANELS TO BE DEPILLARED IN FINAL STAGE
6 POND
7 NALLAH
8 ROAD
9 SURFACE INFRASTRUCTURE
10 INCLINES
11 DRIFTS
PLATE NO. IV
SOUTH EASTERN COALFIELDS LIMITED
BANGWAR UG
PLAN SHOWING PROPOSED LAYOUT OF UNDERGROUND WORKINGS OF SEAM VIB
CMPDI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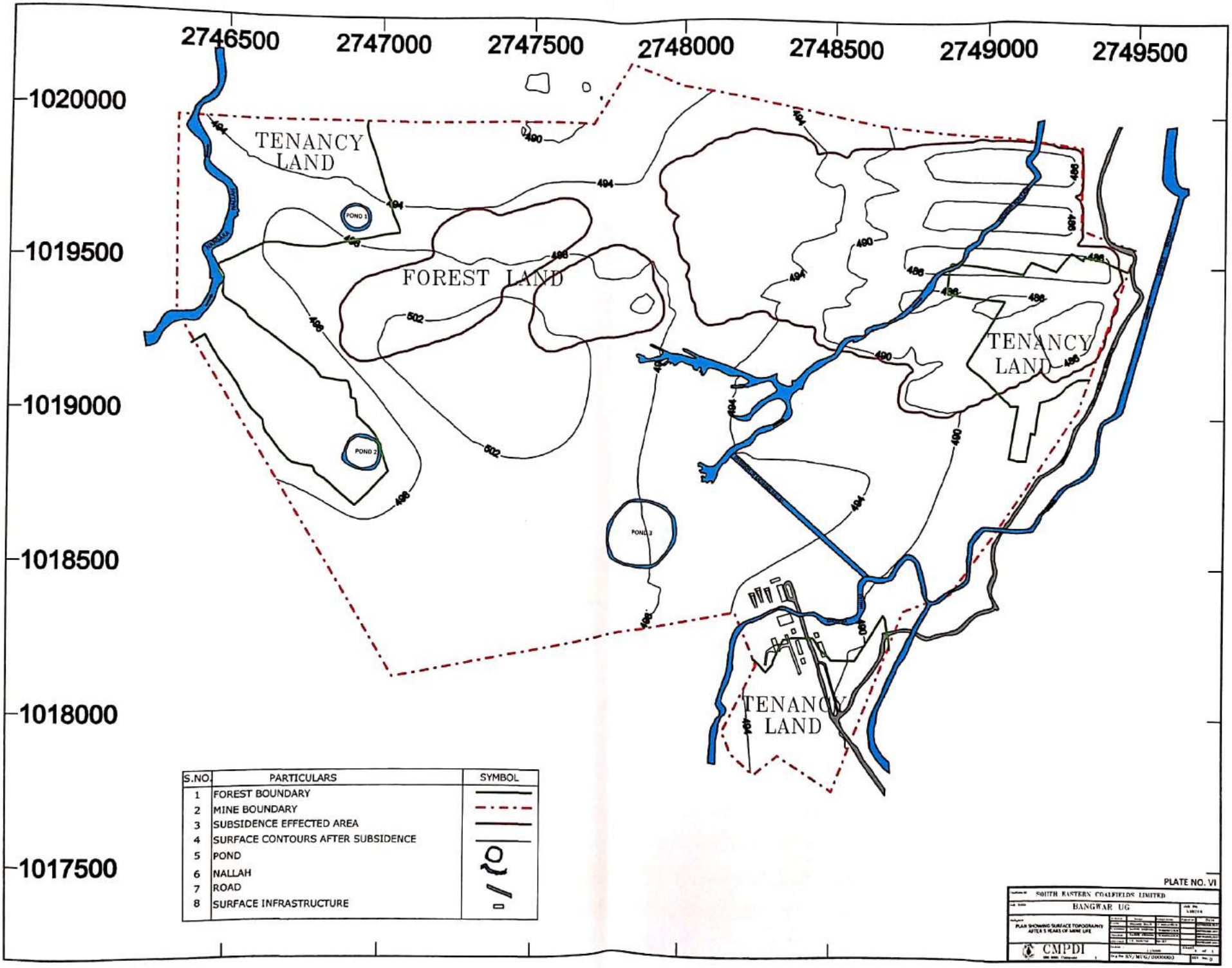
POND 1
POND 2
POND 3
OUTCROP SEAM VIB
OUTCROP SEAM VIB
S.NO. PARTICULARS SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 POND
4 NALLAH
5 ROAD
6 SURFACE INFRASTRUCTURE
7 SUBSIDENCE EFFECTED AREA
8 SUBSIDENCE CONTOURS REPRESENTING 1 m
9 SUBSIDENCE CONTOURS REPRESENTING 2 m
10 SUBSIDENCE CONTOURS REPRESENTING 2.5 m
PLATE NO. V
SOUTH EASTERN COALFIELDS LIMITED
BANGWAR UG
PLAN SHOWING SUBSIDENCE CONTOURS ON SURFACE AFTER 5 YEARS OF MINE LIFE
CMPDI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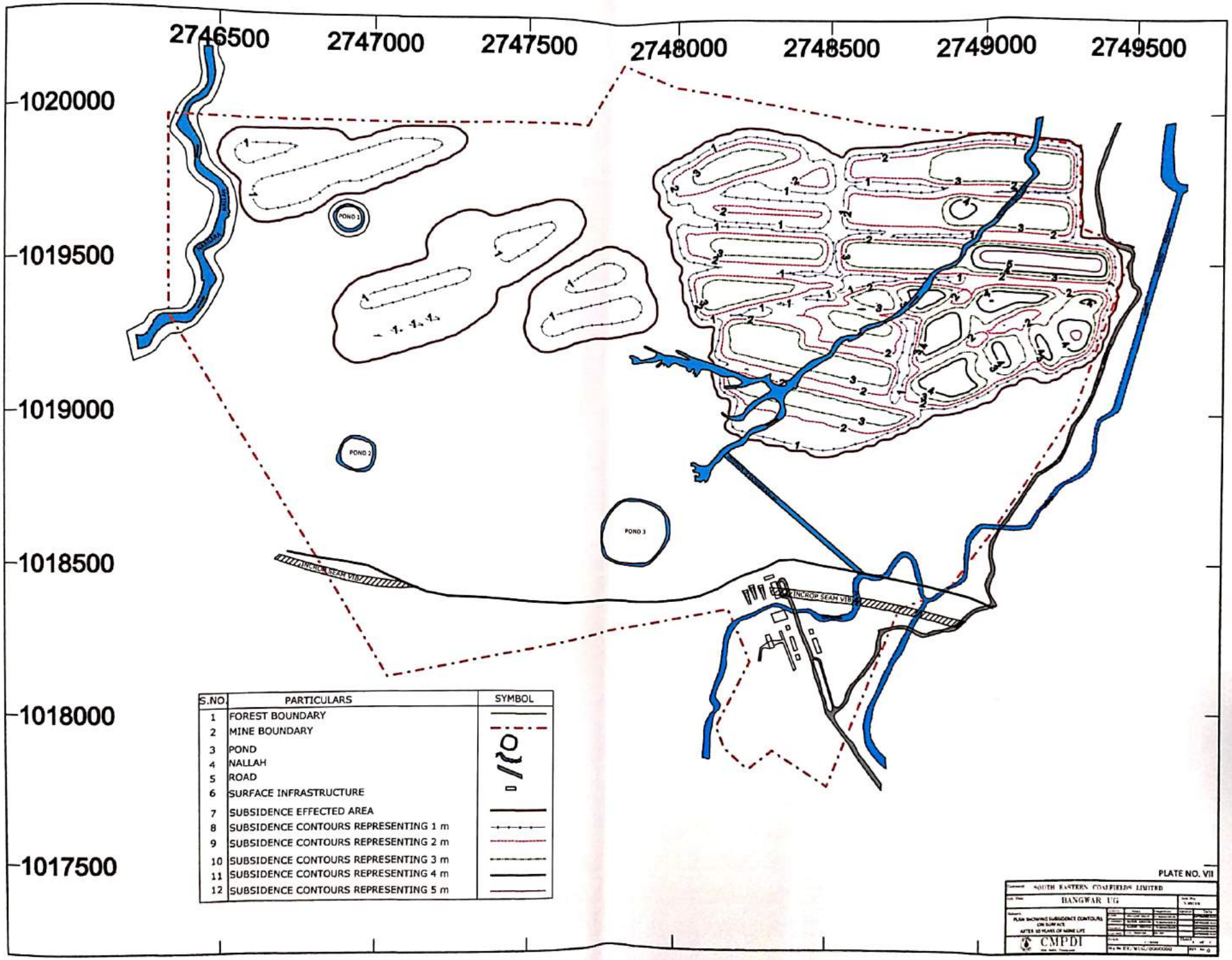
TENANCY LAND
FOREST LAND
TENANCY LAND
TENANCY LAND
POND 1
POND 2
POND 3
494
490
498
502
486
S.NO.
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 SUBSIDENCE EFFECTED AREA
4 SURFACE CONTOURS AFTER SUBSIDENCE
5 POND
6 NALLAH
7 ROAD
8 SURFACE INFRASTRUCTURE
PLATE NO. VI
SOUTH EASTERN COALFIELDS LIMITED
BANGWAR UG
PLAN SHOWING SURFACE TOPOGRAPHY AFTER 5 YEARS OF MINE LIFE
CMPDI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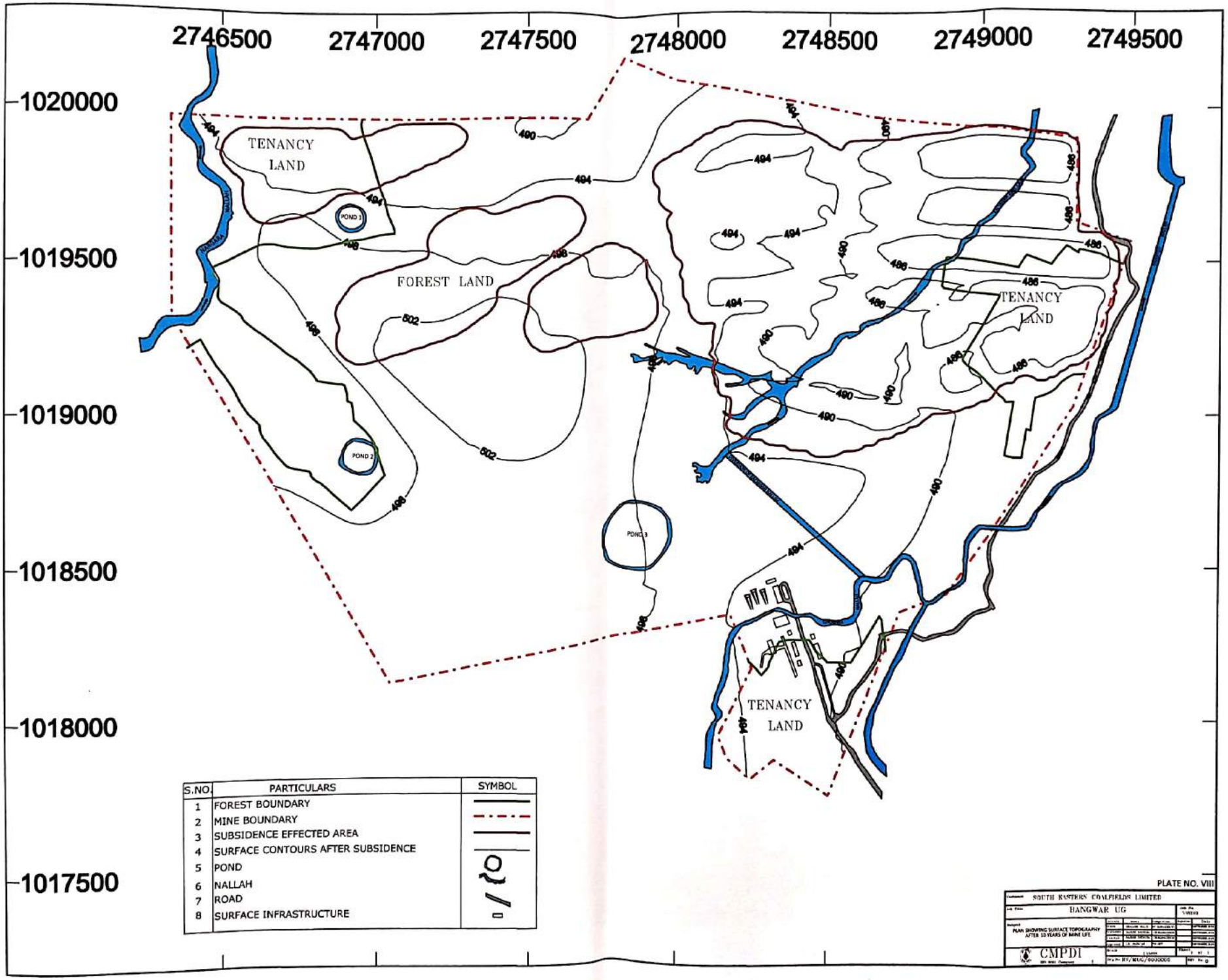
POND 1
POND 2
POND 3
OUTCROP SEAM VIB
OUTCROP SEAM VIB
S.NO.
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 POND
4 NALLAH
5 ROAD
6 SURFACE INFRASTRUCTURE
7 SUBSIDENCE EFFECTED AREA
8 SUBSIDENCE CONTOURS REPRESENTING 1 m
9 SUBSIDENCE CONTOURS REPRESENTING 2 m
10 SUBSIDENCE CONTOURS REPRESENTING 3 m
11 SUBSIDENCE CONTOURS REPRESENTING 4 m
12 SUBSIDENCE CONTOURS REPRESENTING 5 m
PLATE NO. VII
SOUTH EASTERN COALFIELDS LIMITED
BANGWAR UG
CMPDI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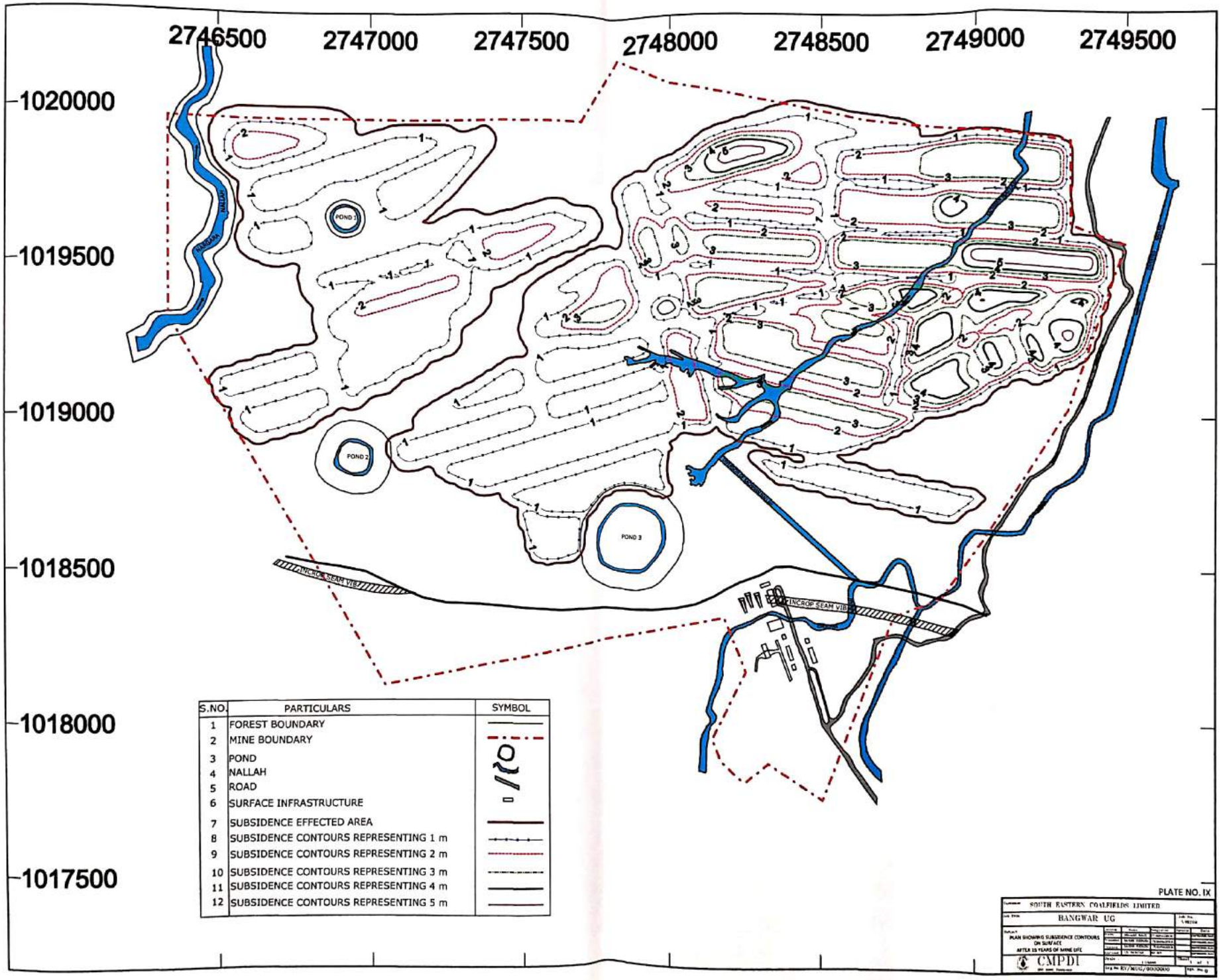
TENANCY LAND
FOREST LAND
TENANCY LAND
TENANCY LAND
POND 1
POND 2
POND 3
494
490
498
502
486
S.NO
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 SUBSIDENCE EFFECTED AREA
4 SURFACE CONTOURS AFTER SUBSIDENCE
5 POND
6 NALLAH
7 ROAD
8 SURFACE INFRASTRUCTURE
PLATE NO. VIII
SOUTH EASTERN COALFIELDS LIMITED
HANGWAR UG
PLAN SHOWING SURFACE TOPOGRAPHY AFTER 15 YEARS OF MINE LIFE
CMPDI



S.NO.	PARTICULARS	SYMBOL
1	FOREST BOUNDARY	
2	MINE BOUNDARY	
3	POND	
4	NALLAH	
5	ROAD	
6	SURFACE INFRASTRUCTURE	
7	SUBSIDENCE EFFECTED AREA	
8	SUBSIDENCE CONTOURS REPRESENTING 1 m	
9	SUBSIDENCE CONTOURS REPRESENTING 2 m	
10	SUBSIDENCE CONTOURS REPRESENTING 3 m	
11	SUBSIDENCE CONTOURS REPRESENTING 4 m	
12	SUBSIDENCE CONTOURS REPRESENTING 5 m	

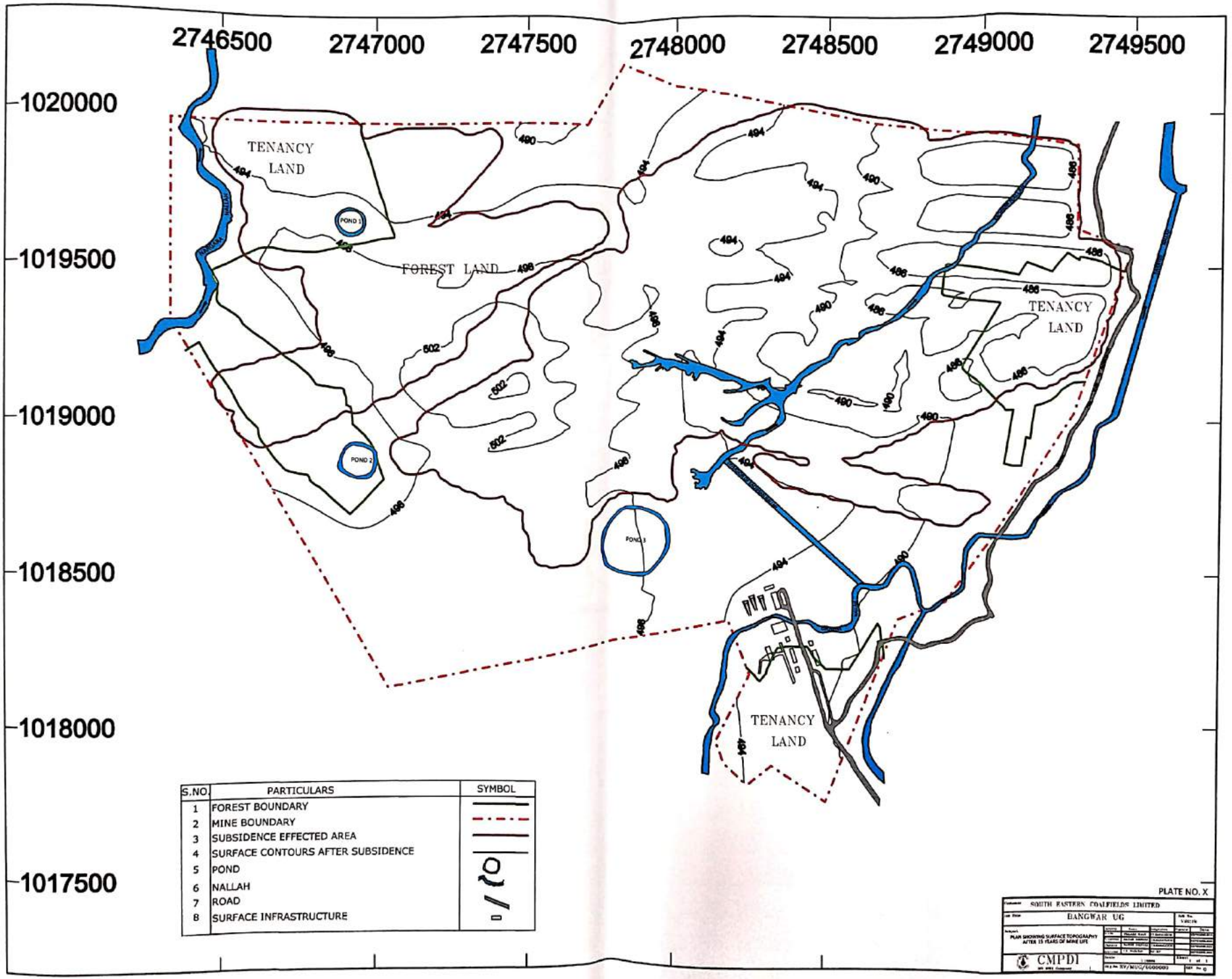
PLATE NO. IX

SOUTH EASTERN COALFIELDS LIMITED

BANGWAR UG

PLAN SHOWING SUBSIDENCE CONTOURS ON SURFACE AFTER 15 YEARS OF MINE LIFE

CMPDI



S.NO.	PARTICULARS	SYMBOL
1	FOREST BOUNDARY	
2	MINE BOUNDARY	
3	SUBSIDENCE EFFECTED AREA	
4	SURFACE CONTOURS AFTER SUBSIDENCE	
5	POND	
6	NALLAH	
7	ROAD	
8	SURFACE INFRASTRUCTURE	

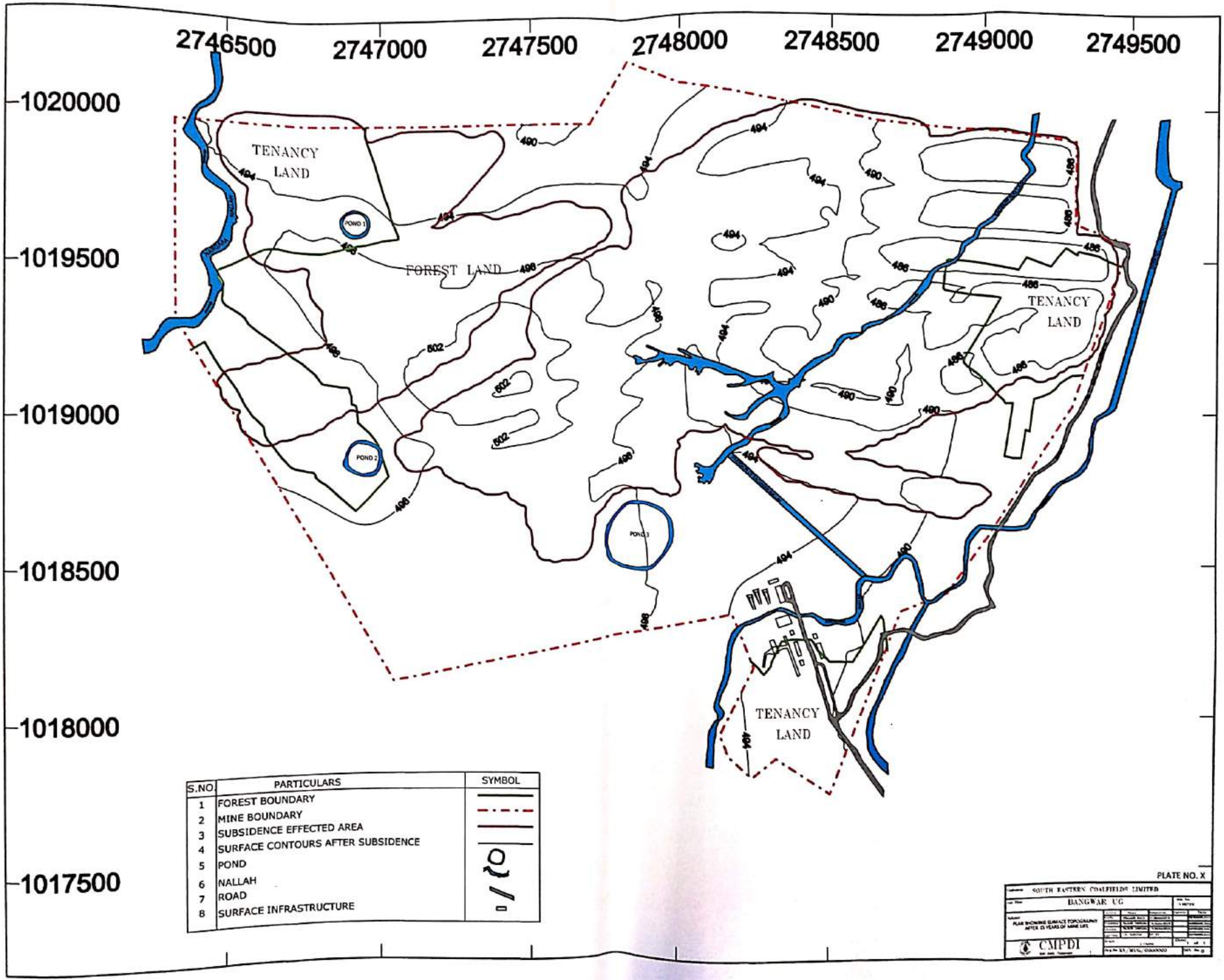
PLATE NO. X

SOUTH EASTERN COALFIELDS LIMITED

BANGWAR UG

PLAN SHOWING SURFACE TOPOGRAPHY AFTER 15 YEARS OF MINE LIFE

CMPDI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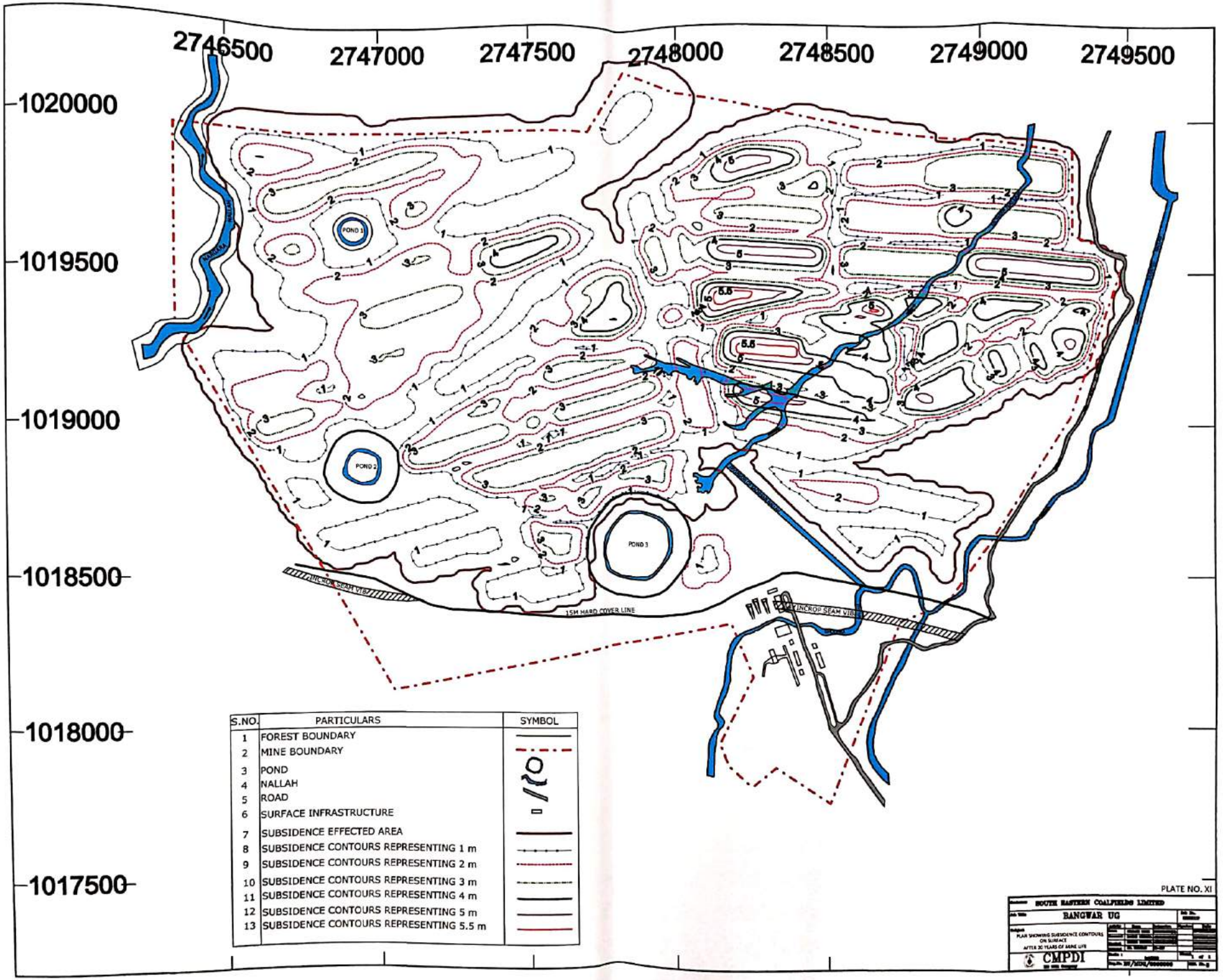
TENANCY LAND
FOREST LAND
TENANCY LAND
TENANCY LAND
POND 1
POND 2
POND 3
494
490
498
502
S.NO.
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 SUBSIDENCE EFFECTED AREA
4 SURFACE CONTOURS AFTER SUBSIDENCE
5 POND
6 NALLAH
7 ROAD
8 SURFACE INFRASTRUCTURE
PLATE NO. X
SOUTH EASTERN COALFIELDS LIMITED
BANGWAR UG
CMPDI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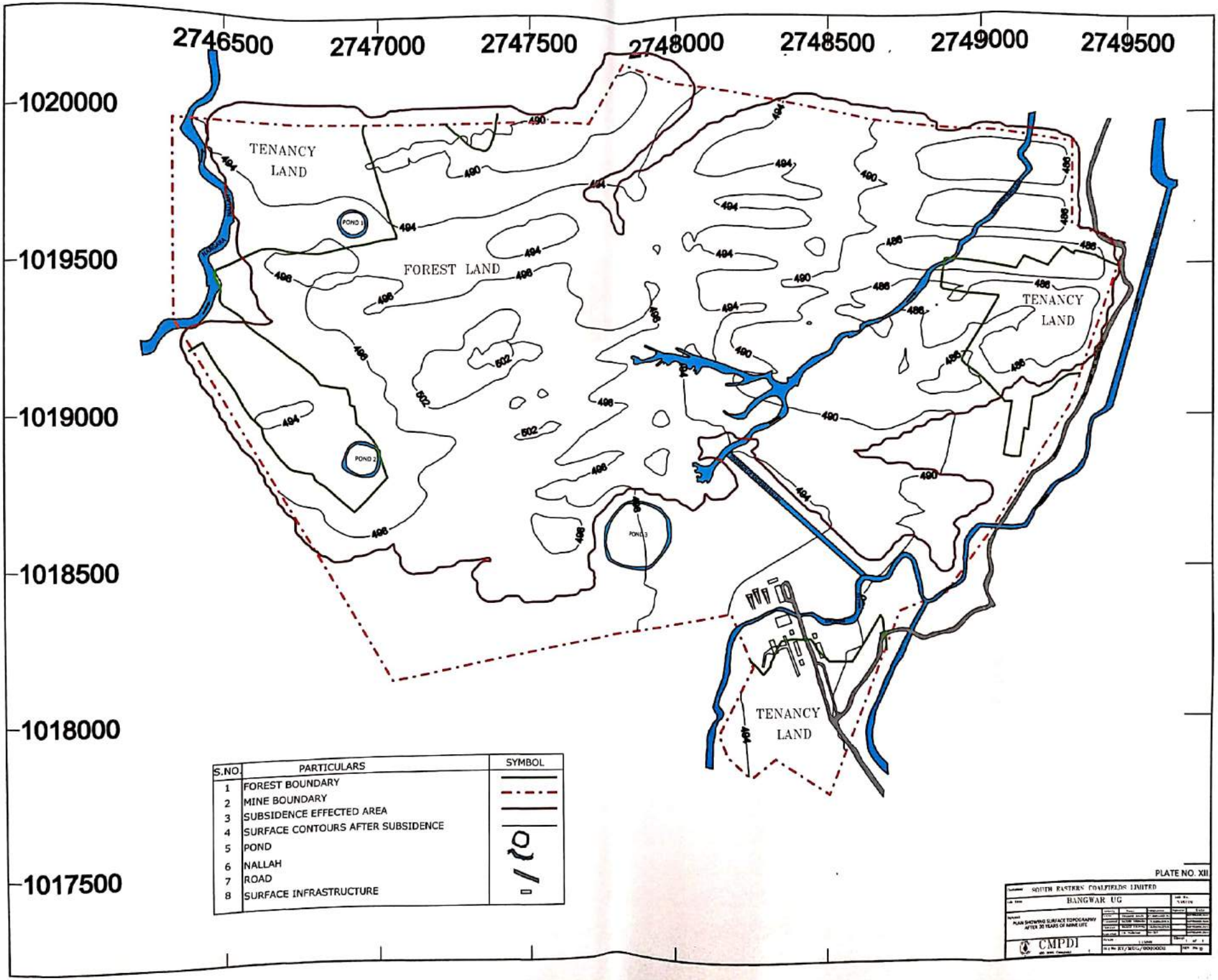
POND 1
POND 2
POND 3
15M HARD COVER LINE
INCROP SEAM VIB
INCROP SEAM VIB
S.NO.
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 POND
4 NALLAH
5 ROAD
6 SURFACE INFRASTRUCTURE
7 SUBSIDENCE EFFECTED AREA
8 SUBSIDENCE CONTOURS REPRESENTING 1 m
9 SUBSIDENCE CONTOURS REPRESENTING 2 m
10 SUBSIDENCE CONTOURS REPRESENTING 3 m
11 SUBSIDENCE CONTOURS REPRESENTING 4 m
12 SUBSIDENCE CONTOURS REPRESENTING 5 m
13 SUBSIDENCE CONTOURS REPRESENTING 5.5 m
PLATE NO. XI
SOUTH EASTERN COALFIELDS LIMITED
BANGWAR UG
PLAN SHOWING SUBSIDENCE CONTOURS ON SURFACE AFTER 30 YEARS OF MINE LIFE
CMPDI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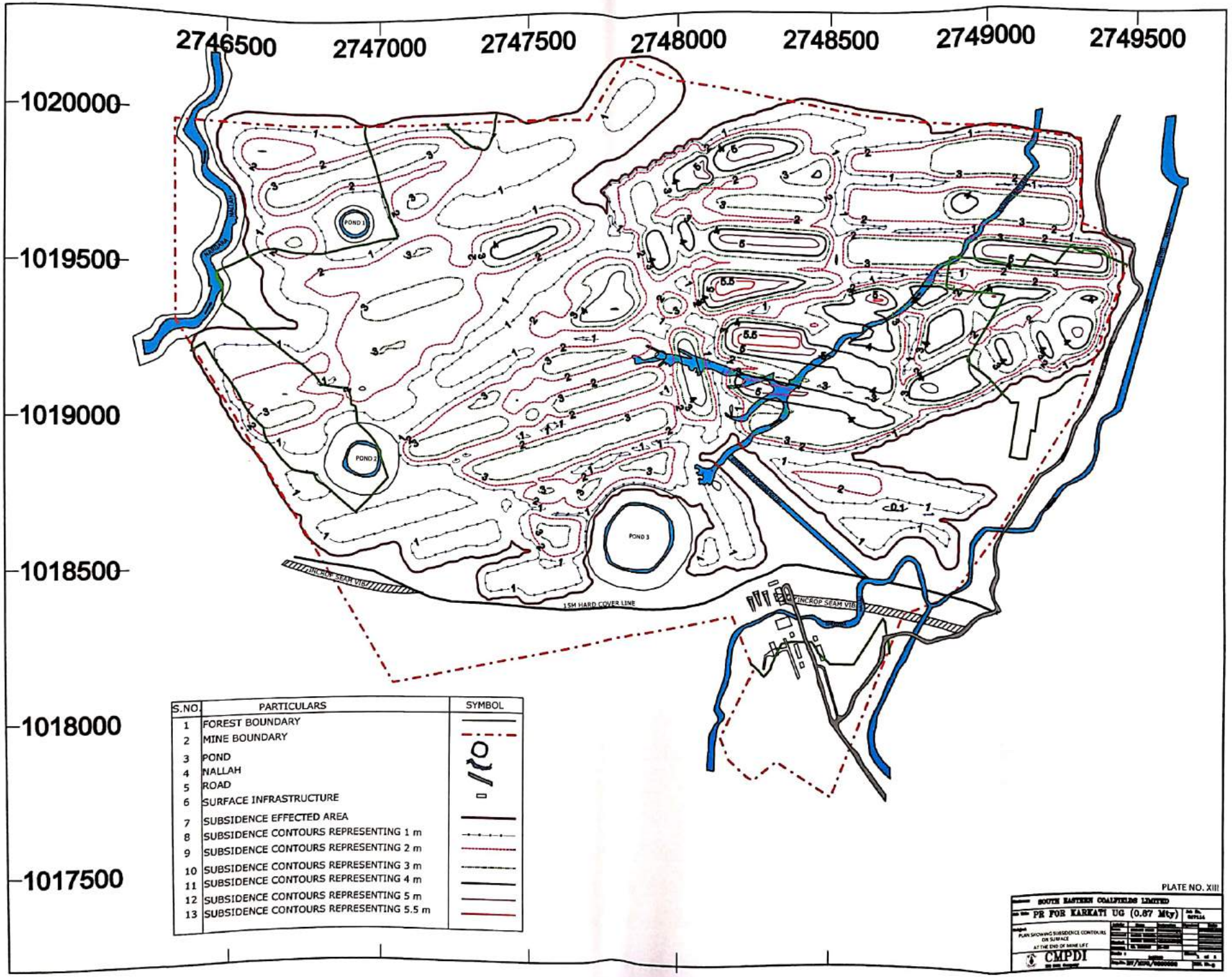
FOREST LAND
TENANCY LAND
TENANCY LAND
POND 1
POND 2
POND 3
BANGWA
490
494
496
502
S.NO.
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 SUBSIDENCE EFFECTED AREA
4 SURFACE CONTOURS AFTER SUBSIDENCE
5 POND
6 NALLAH
7 ROAD
8 SURFACE INFRASTRUCTURE
PLATE NO. XII
SOUTH EASTERN COALFIELDS LIMITED
BANGWAR UG
PLAN SHOWING SURFACE TOPOGRAPHY AFTER 20 YEARS OF MINE LIFE
CMPDI



S.NO.	PARTICULARS	SYMBOL
1	FOREST BOUNDARY	
2	MINE BOUNDARY	
3	POND	
4	NALLAH	
5	ROAD	
6	SURFACE INFRASTRUCTURE	
7	SUBSIDENCE EFFECTED AREA	
8	SUBSIDENCE CONTOURS REPRESENTING 1 m	
9	SUBSIDENCE CONTOURS REPRESENTING 2 m	
10	SUBSIDENCE CONTOURS REPRESENTING 3 m	
11	SUBSIDENCE CONTOURS REPRESENTING 4 m	
12	SUBSIDENCE CONTOURS REPRESENTING 5 m	
13	SUBSIDENCE CONTOURS REPRESENTING 5.5 m	

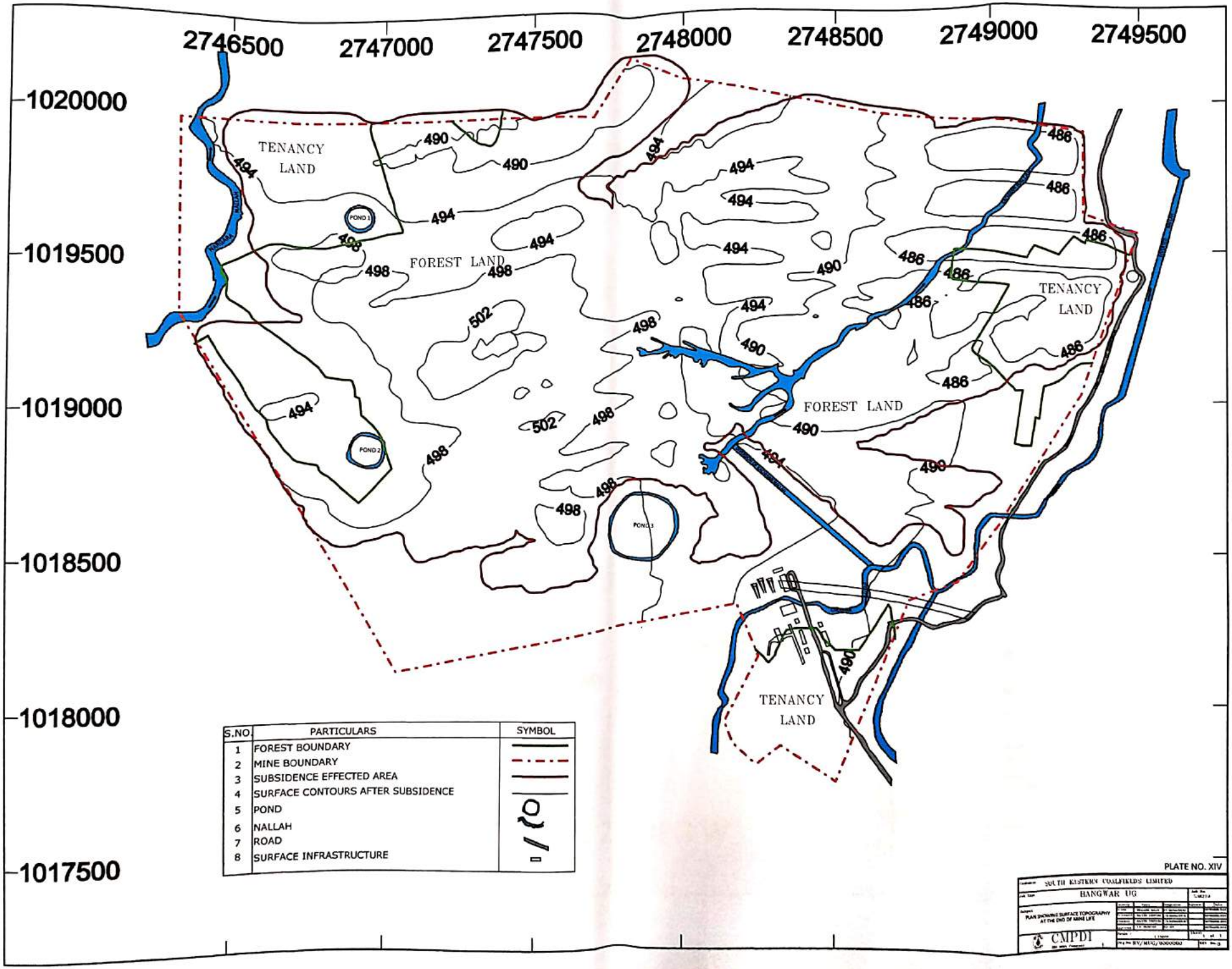
PLATE NO. XIII

SOUTH EASTERN COALFIELDS LIMITED

PR FOR KARKATI UG (0.87 Mty)

PLAN SHOWING SUBSIDENCE CONTOURS ON SURFACE AT THE END OF MINE LIFT

CMPDI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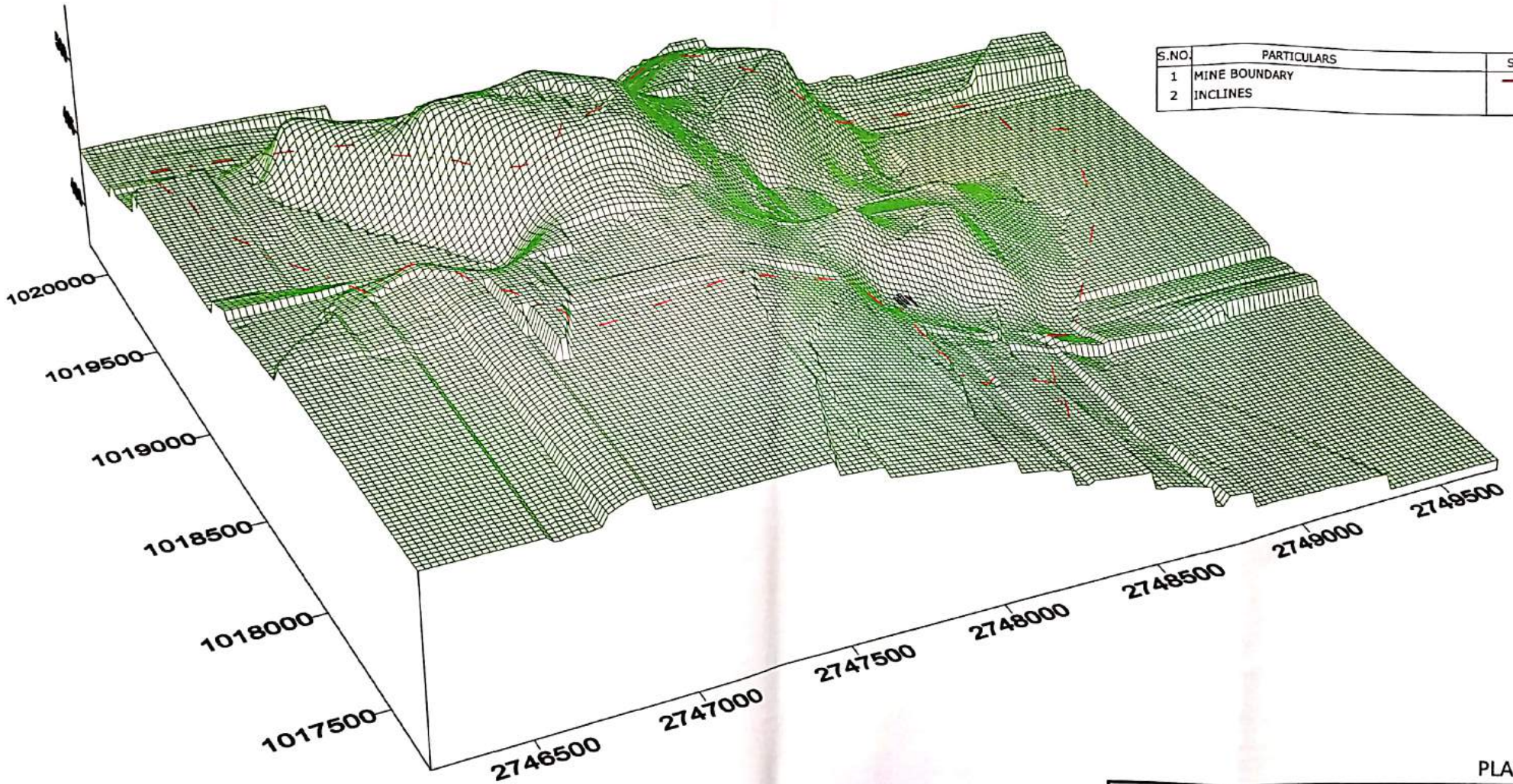
FOREST LAND
TENANCY LAND
FOREST LAND
TENANCY LAND
POND 1
POND 2
POND 3
NALLAH
NALLAH
490
494
498
502
486
S.NO.
PARTICULARS
SYMBOL
1 FOREST BOUNDARY
2 MINE BOUNDARY
3 SUBSIDENCE EFFECTED AREA
4 SURFACE CONTOURS AFTER SUBSIDENCE
5 POND
6 NALLAH
7 ROAD
8 SURFACE INFRASTRUCTURE
PLATE NO. XIV
SOUTH EASTERN COALFIELDS LIMITED
BANGWAR UG
PLAN SHOWING SURFACE TOPOGRAPHY AT THE END OF MINE LIFE
CMPDI

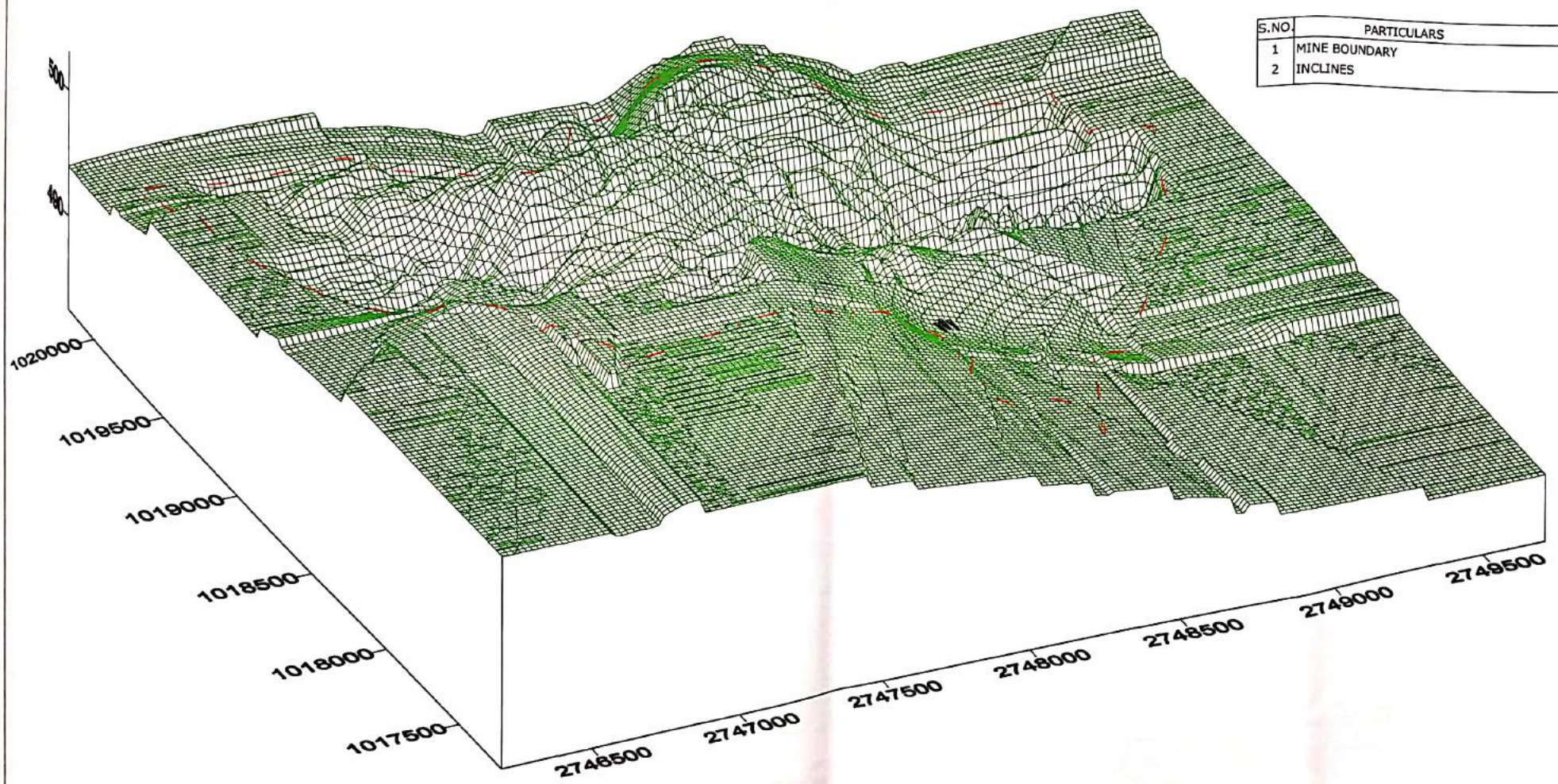


S.NO.	PARTICULARS	SYMBOL
1	MINE BOUNDARY	
2	INCLINES	

VIEW DIRECTION- N 25 DEG W

PLATE NO. XV

Customer	SOUTH EASTERN COALFIELDS LIMITED				
Job Title	BANGWAR UG				Job No. 538219
Subject		Activity	Name	Designation	Signature / Date
PLAN SHOWING 3D VIEW OF SURFACE BEFORE MINING		Drawn	SHALABH MALIK	DY.MANAGER(M)	SEPTEMBER,2019
		Processed	RAJESH DHINGRA	CH.MANAGER(M)	SEPTEMBER,2019
		Checked	RAJESH DHINGRA	CH.MANAGER(M)	SEPTEMBER,2019
		Approved	I.D. NARAYAN	GD-RIV	SEPTEMBER,2019
CMPDI ISO 9001 Company		Scale : NTS			Sheet 1 of 1
		Drg.No. RV/MUG/0000000			REV. No. 0

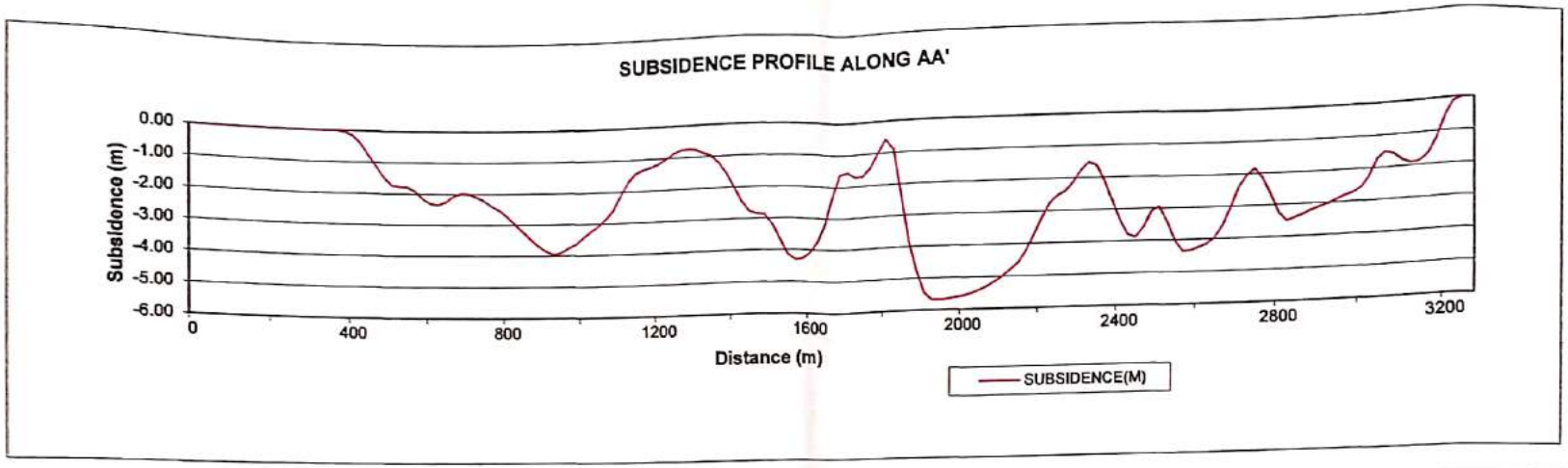


S.NO.	PARTICULARS	SYMBOL
1	MINE BOUNDARY	
2	INCLINES	

VIEW DIRECTION- N 25 DEG W

PLATE NO. XVI

Customer	SOUTH EASTERN COALFIELDS LIMITED				
Job Title	BANGWAR UG				Job No. 530219
Subject	PLAN SHOWING 3D VIEW OF SURFACE AFTER MINING	Activity	Name	Designation	Signature / Date
		Drawn	SHALABH MALIK	DY.MANAGER(M)	SEPTEMBER,2011
		Processed	RAJESH DHINGRA	CH.MANAGER(M)	SEPTEMBER,2011
		Checked	RAJESH DHINGRA	CH.MANAGER(M)	SEPTEMBER,2011
		Approved	I.D. NARAYAN	RD-RIV	SEPTEMBER,2011
CMPDI ISO 9001 Company		Scale : NTS			Sheet 1 of 1
		Drg.No. RV/MUG/0000000			REV. No. 0



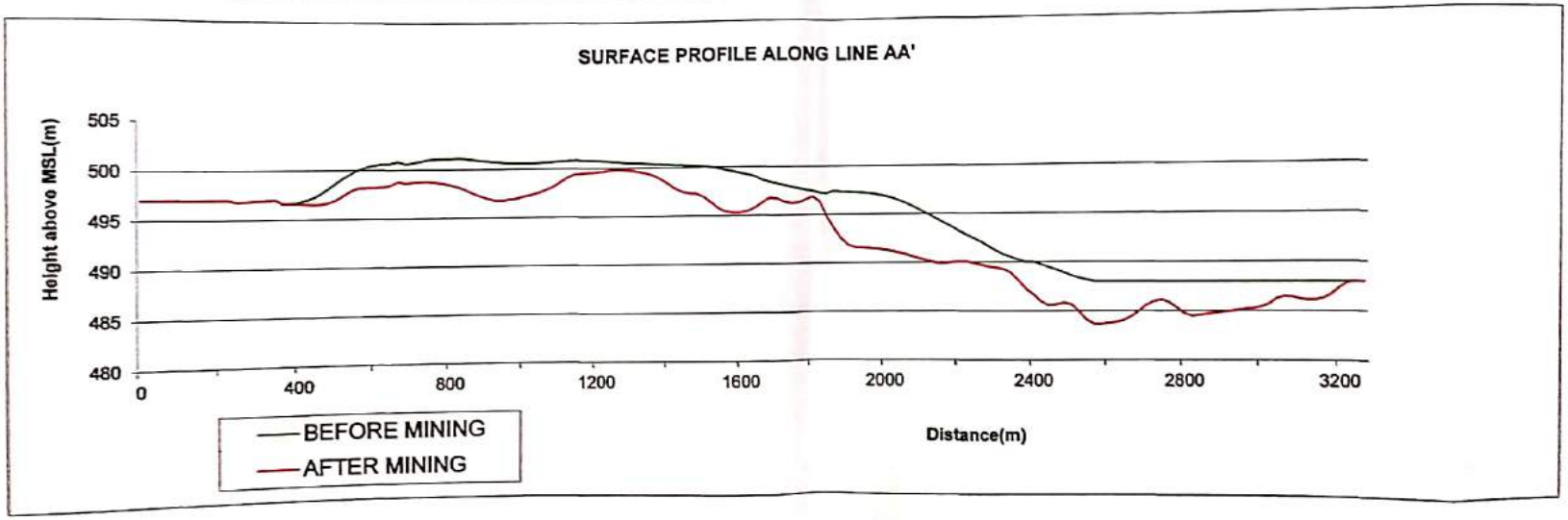
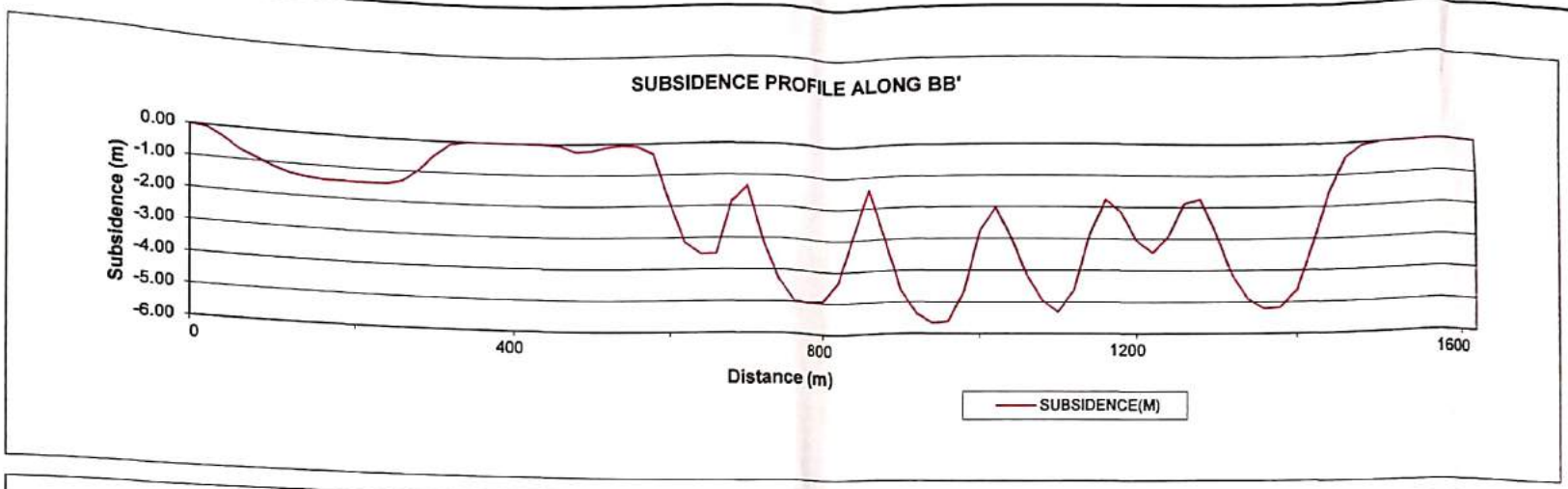


PLATE - XVII

Customer	SOUTH EASTERN COALFIELDS LTD.					
Job Title	BANGWAR UG				Job No. 538219	
Subject	Subsidence and Surface Profiles along AA'	Activity	Name	Designation	Signature	Date
		Drawn	SHALABH MALIK	Dy. Manager (M)		September, 2019
		Processed	Rajesh Dhingra	Ch. Manager (M)		September, 2019
CMPDI		Checked	Rajesh Dhingra	Ch. Manager (M)		September, 2019
		Approved	I D Narayan	RD, RIV		September, 2019



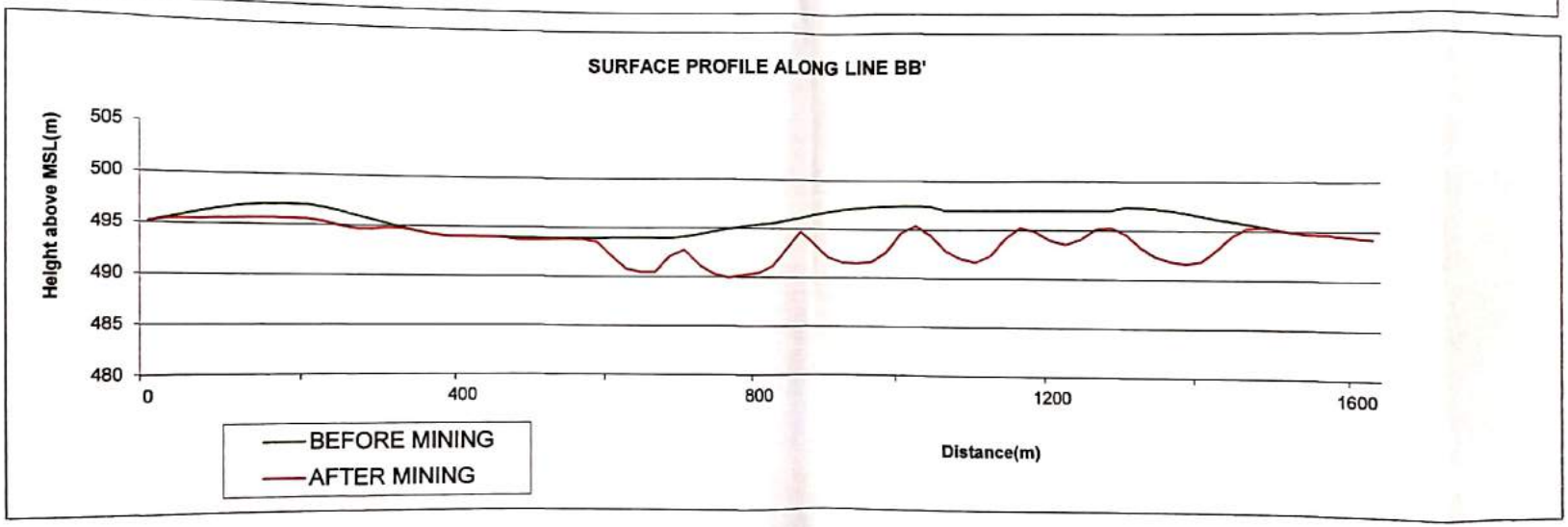


PLATE - XVIII

Customer	SOUTH EASTERN COALFIELDS LTD.					
Job Title	BANGWAR UG				Job No. 538219	
Subject	Subsidence and Surface Profiles along AA'	Activity	Name	Designation	Signature	Date
		Drawn	SHALABH MALIK	Dy. Manager (M)		September, 2019
		Processed	Rajesh Dhingra	Ch. Manager (M)		September, 2019
CMPDI		Checked	Rajesh Dhingra	Ch. Manager (M)		September, 2019
		Approved	I D Narayan	RD, RIV		September, 2019

REGISTERED OFFICE

Gondwana Place, Kanke Road
Ranchi -834 031
(Jharkhand)

REGIONAL INSTITUTES

क्षेत्रीय संस्थान-I
वेस्ट एंड, जी.टी.रोड
आसनसोल-713 301
(पश्चिम बंगाल)

क्षेत्रीय संस्थान-II
कोयला भवन, कोयला नगर
धनबाद- 826 005
(झारखंड)

क्षेत्रीय संस्थान-III
गोंदवाना प्लेस,कांके रोड
राँची- 834 031
(झारखंड)

क्षेत्रीय संस्थान-IV
जरीपटका, कस्तूरबा नगर
नागपुर-440 014
(महाराष्ट्र)

क्षेत्रीय संस्थान-V
सीपत रोड
बिलासपुर-495 001
(छत्तीसगढ़)

क्षेत्रीय संस्थान-VI
पोस्ट :जयंत कॉलरी,
जिला : सिंगरौली
पिन नं0- 486 890
(मध्य प्रदेश)

क्षेत्रीय संस्थान-VII
गृह निर्माण भवन
सचिवालय मार्ग
भुवनेश्वर-751001
(उड़ीसा)

Regional Institute - I
West End, G.T Road
Asansol - 713 301
(West Bengal)

Regional Institute - II
Koyla Bhawan, Koyla Nagar
Dhanbad - 826 005
(Jharkhand)

Regional Institute - III
Gondwana Place, Kanke Road
Ranchi- 834 031
(Jharkhand)

Regional Institute - IV
Jaripathka, Kasturba Nagar
Nagpur - 440 014
(Maharashtra)

Regional Institute - V
Seepat Road
Bilaspur - 495 001
(Chattisgarh)

Regional Institute - VI
P.O Jayant Colliery
Dist. - Singrauli
PIN - 486 890
Madhya Pradesh

Regional Institute - VII
Grih Nirman Bhawan
Sachivalaya Marg
Bhubneswar - 751 001
(Orissa)

सेन्ट्रल माईन प्लानिंग एंड डिजाइन इन्स्टीच्यूट लिमिटेड

(कोल इंडिया की अनुषंगी कम्पनी)
एक मिनी रत्न कम्पनी

Central Mine Planning & Design Institute Limited

(A Subsidiary of Coal India Limited)
A Mini Ratna Company

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